EVALUATION OF CODGELS CREEK MCB CAMP LEJEUNE NC

11/1/1998

CH2M HILL

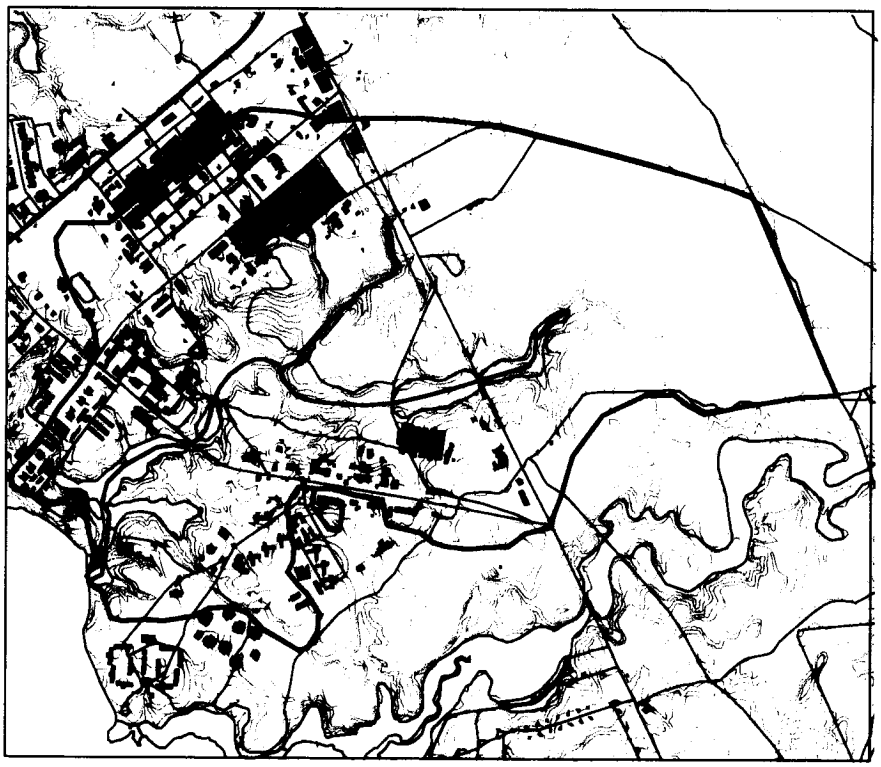
Evaluation of Cogdel's Creek

Marine Corps Base Camp Lejeune, North Carolina

Prepared for:

U. S. Army Corps of Engineers

Contract No. DACA01-96-D-0028, Delivery Order No. 0025



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CH2M HILL Project Number 142842

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Introduction

The purpose of this report is to present the results of the Evaluation of Cogdel's Creek at Marine Corps Base (MCB) Camp Lejeune, North Carolina. Figure 1 shows the general study area location, and Figure 2 shows the Cogdel's Creek watershed boundary. Cogdel's Creek is in a developed area of Camp Lejeune, and has been impacted by Base activities in the watershed. The primary problems, and the focus of this report, are erosion in the drainage basin and sedimentation in the creek itself.

Following this introduction, the report is divided into the following sections, which were developed in chronological order throughout the evaluation:

- Watershed Assessment
- Remediation Plan
- Long-term Watershed Management Plan

A draft *Watershed Assessment of Cogdel's Creek*, developed in May 1998, documented the watershed condition and presented three alternatives for remediation. The alternatives were discussed at a meeting with regulatory agencies in order to select the preferred remediation plan. A draft *Remediation Plan for Cogdel's Creek* was completed in August 1998 and finalized in October 1998. The draft Long-term Watershed Management Plan developed in October 1998. This final report combines all three elements, addressing comments on the draft documents. In addition to being included in this document, the *Remediation Plan* was also bound separately for distribution to regulatory agencies in November 1998.

Watershed Assessment

The watershed assessment of Cogdel's Creek specifically focused on identifying erosion and sedimentation problems, and evaluating three remediation alternatives for addressing the problems. Following discussion of the three alternatives presented here with the U. S. Army Corps of Engineers, MCB Camp Lejeune, and regulatory agency staff, the remediation plan was developed based on the selected alternative.

Wildlife

No threatened or endangered species were encountered during the field surveys. Suitable habitat for red-cockaded woodpeckers (*Picoides borealis*) exists in the western headwaters of the watershed. The US Fish and Wildlife Service and the State of North Carolina list the red-cockaded woodpecker as an endangered species. The habitat areas are mapped as pine flatwoods on Figure 3. The potential habitat areas identified during the field survey are adjacent to areas outside the watershed that are used by the woodpeckers on MCB Camp Lejeune.

Beaver dams and muskrat lodges were identified by reviewing aerial photographs of the watershed, and conducting limited ground truthing. No mound-type muskrat lodges were identified in the watershed. This does not mean that muskrat do not occur in the watershed because this species is known to construct or occupy abandoned bank lodges. Bank lodges typically have underwater entrances that are difficult to locate.

One historic beaver dam was identified on the aerial photographs upstream of the culverted crossing of the creek at the tank crossing near P804. The dam has numerous trees growing on it and has been breached in a number of places. It does not appear to be having a significant impact on the creek because of the breaches and the lack of backwater areas typically associated with functioning dams. No active beaver dams were identified in the watershed and no mound-type lodges were found.

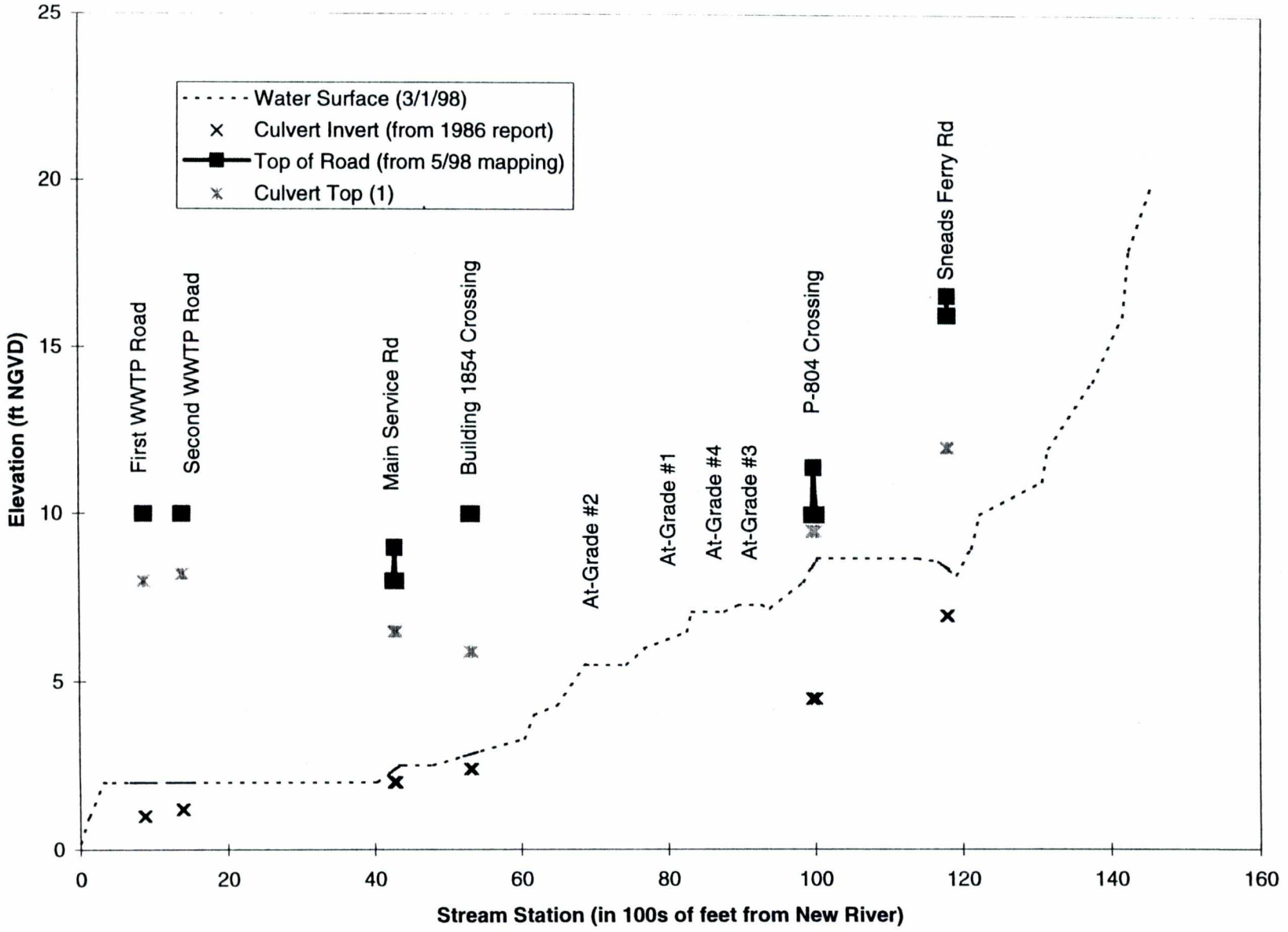
Stream Channel

Hydrology and Channel Elevations

Topographic mapping from aerial photography flown on March 1, 1998 was used along with October 1997 field observations to approximate a channel profile for Cogdel's Creek (Figure 6). In addition, culvert invert elevations were obtained from the *Evaluation of Peak Storm Water Runoff in Cogdel's Creek Watershed* (Ecology and Environment, Inc., 1986, prepared for the Department of the Navy, Atlantic Division). Invert elevations for the two crossings near the wastewater treatment plant (WWTP) were estimated from the size and top of road elevation, since invert elevations were not included in the 1986 study. Figure 6 illustrates the sedimentation that has taken place, especially in the area of the at-grade tank crossings.

The hydrology of Cogdel's Creek is controlled by a number of culvert and at-grade crossings that restrict flow (shown in Figure 7), which are discussed in detail below. During October 1997 field visits, sediment and/or vegetation significantly obstructed most culverts. Increased flow from developed areas does not appear to have caused streambank erosion problems, since sedimentation at culverts increases in-stream attenuation of flow.

Under design conditions (i.e. with no at-grade crossings and free-flowing culverts), the 1986 hydrologic model of the Cogdel's Creek watershed did not show any adverse flooding impacts from the culverts. This modeling was based on what were at the time future conditions, which are representative of existing conditions today. Attenuation by the uppermost culverts (above P804 and Sneads Ferry Road) reduced peak 10-year discharge rates by 50 percent. Based on 1992 Stormwater Discharge System maps provided by MCB Camp Lejeune, and field observations, it appears that some of the culverts may have been replaced and enlarged since then.



(1) Culvert top is based on invert and size.

Figure 6
Cogdel's Creek Channel Profile

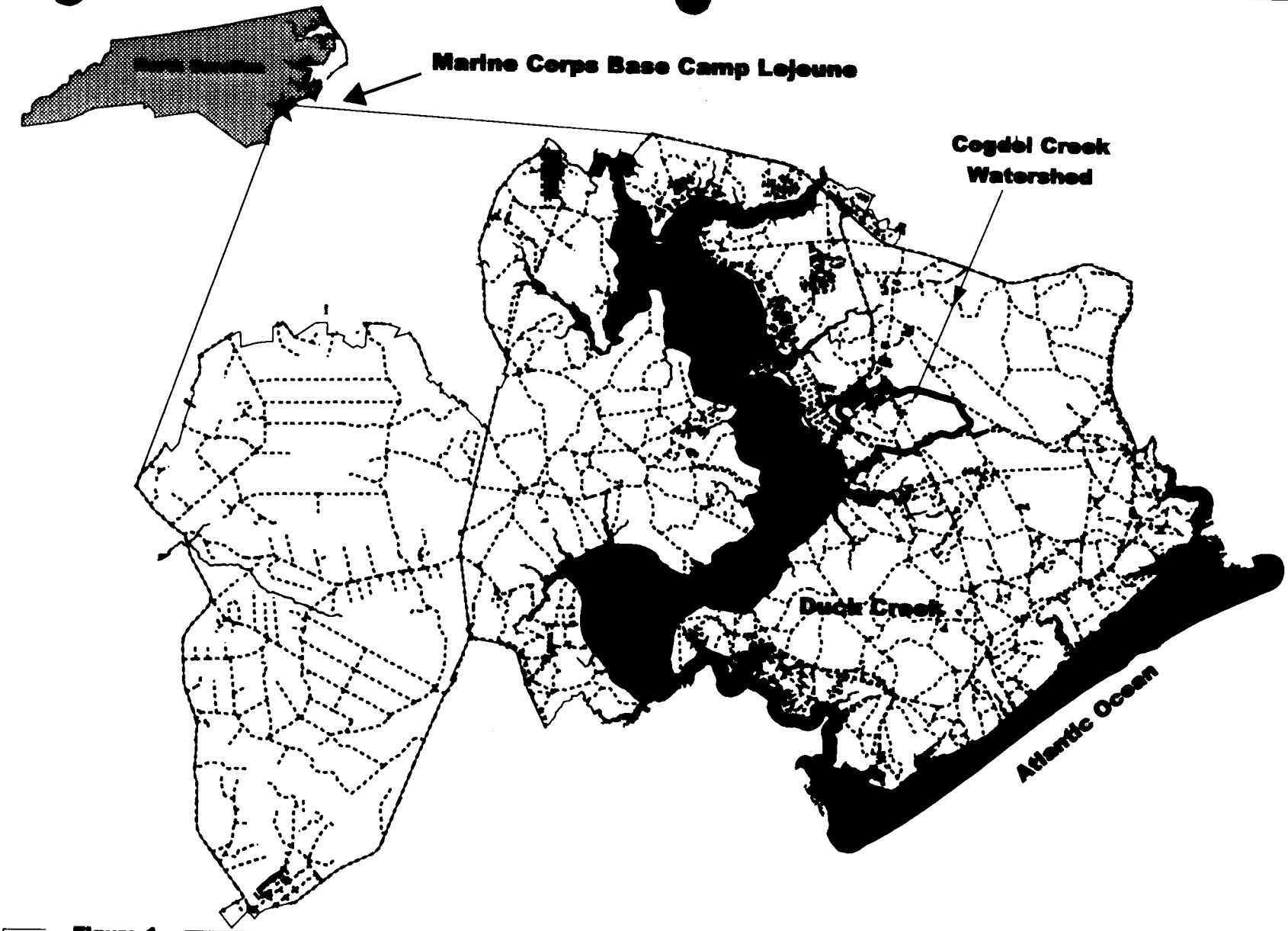


Figure 1

Project Location
Cogdel's Creek Watershed

10000 0 10000 20000 Feet

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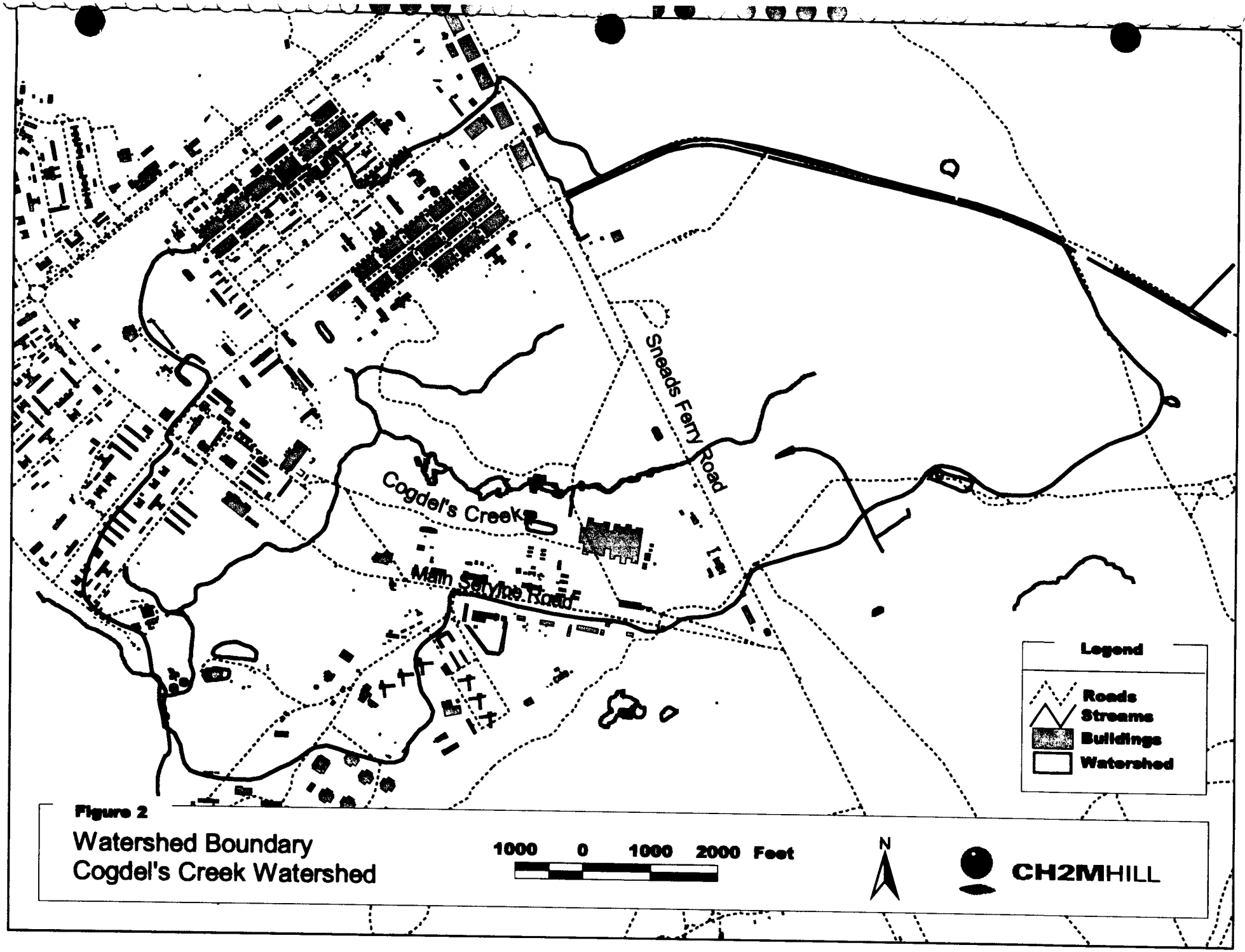


Figure 2

Watershed Boundary
Cogdel's Creek Watershed

Although overall impervious area is probably less than 30 percent of the watershed, some subareas have concentrated pavement/building areas, and there are large areas used for maneuvering or storing heavy vehicles that are unpaved and unvegetated. Urban land uses in the northern portion of the watershed began when Camp Lejeune was developed, while the southern portion (French Creek area) was developed more recently.

Vegetation

Vegetative communities within the Cogdel's Creek watershed were assessed using aerial photo-interpretation and field sampling methods. Several types of vegetative communities within the Cogdel's Creek watershed were compared to respectively similar communities within a reference watershed to determine whether vegetative associations within the Cogdel's Creek watershed differ significantly from those areas that have not been impacted by sedimentation and other base-related disturbances. This section describes the types of vegetative communities that exist within the Cogdel's Creek watershed and compares the community structure of Cogdel's Creek with that of an undisturbed system. The types of vegetative impacts associated with base-related activities are discussed in the Erosion/Sedimentation Impacts section.

Methodology

The approximate coverage of each type of vegetative community within the Cogdel's Creek watershed was estimated from 1997 rectified orthophoto aerial photographs (scale 1:2,400). The major vegetative communities within the Cogdel's Creek watershed were mapped based on aerial photo-interpretation and field ground truthing. Field investigations for ground truthing photo-interpretations, assessing plant species composition and cover, and evaluating obvious signs of impacts to vegetative communities within the Cogdel's Creek watershed were conducted during a field visit on October 26 - 30, 1997. Concomitant field studies were conducted in the Duck Creek watershed, an adjacent watershed that was chosen to represent an undisturbed system for comparison. Duck Creek is also shown in Figure 1. Several vegetative communities within the Cogdel's Creek watershed were compared to respectively similar communities within the Duck Creek watershed to determine if the watersheds differ significantly from one another with respect to plant species composition, vegetative cover, and other community characteristics.

The vegetative community structures of the Cogdel's Creek and Duck Creek watersheds were determined by assessing the plant species composition and cover of randomly-selected sampling stations within each type of vegetative community. The location of each sampling station was recorded using GPS and recorded on GIS maps. The percent vegetative cover of all plant species in the canopy and subcanopy (saplings and shrubs) strata were visually estimated within a circular plot having a 10-meter radius that was randomly located within the vegetative community. Tree basal area of the community was also estimated by measuring the diameter-at-breast-height (dbh) of each tree within the 10-meter circular plot. The herbaceous (ground) cover of the community was evaluated by determining the plant species composition and percent cover within a 1-square meter quadrant randomly located within the 10-meter circular plot.

The vegetative community structures of the two watersheds were then compared to determine if the Cogdel's Creek watershed differs significantly from an undisturbed system with respect to vegetative community parameters such as vegetative cover and species

diversity. Inferences were also made where appropriate to correlate the sampling data and other field observations to impacts associated with sediment input and channel flow restrictions.

Vegetative Community Structure

The coverage of the major vegetative associations that exist within the Cogdel's Creek watershed is shown in Figure 3. Based on total areal coverage, the mixed wetland forest and mixed upland forest associations are the dominant vegetative communities within the watershed. Together, the mixed wetland forest and mixed upland forest associations constitute approximately 45 percent of the total land cover within the watershed. Urban areas constitute approximately 39 percent of the watershed area. The other vegetative associations, along with cleared areas such as the tank/testing area, each comprise a small percentage of the remaining watershed land cover. Table 1 summarizes the percent coverage of each community.

Table 1. Land Cover Areas
Cogdel's Creek Watershed

Land Cover	Approximate Area (acres)	Percent of Watershed
Clear-Cut Areas	90	4
Pine Flatwoods	60	3
Shrub Wetlands	<10	<1
Open Fields	11	<1
Mixed Wetland Forest	400	19
Mixed Upland Forest	550	26
Floodplain Swamp	29	1
Floodplain Marsh	28	1
Other	113	6
Urban	825	39
Total	2116	100

All of the vegetative communities that were assessed in the field showed signs of major storm event damage, probably sustained during Hurricanes Bertha and Fran in 1996. Damage to most communities was limited to less than 20 percent of the trees being toppled or partially toppled.

Several types of the wetland and upland vegetative associations were randomly sampled to evaluate the community structure within the headwaters, middle reach, and downstream portions of the watershed. The community structure characteristics of the vegetative associations that were sampled in the Cogdel's Creek watershed are described Attachment A.

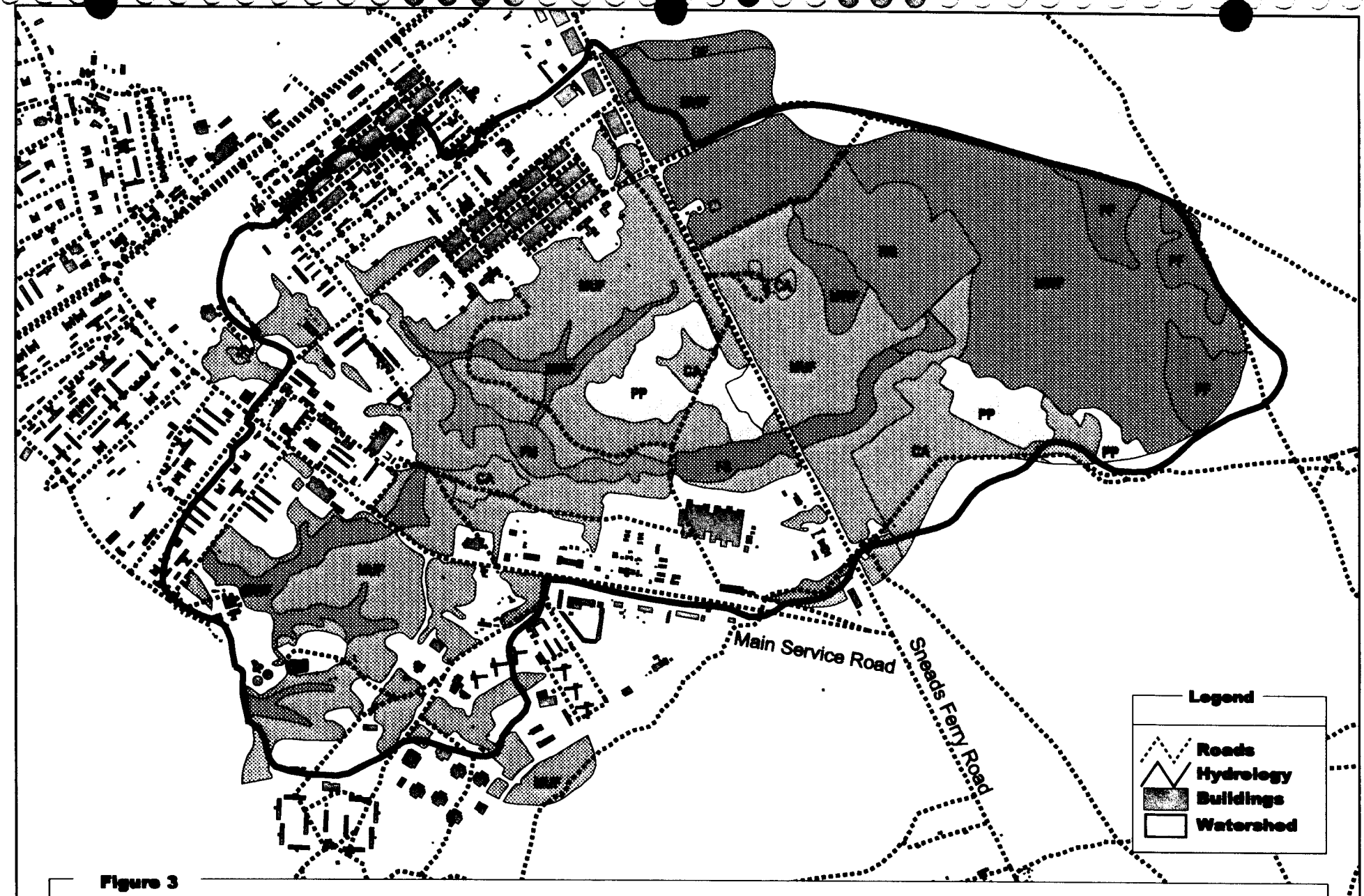


Figure 3

Vegetative Communities
Cogdel's Creek Watershed

Clear-Cut Areas

Three clear-cut areas within the headwaters region of Cogdel's Creek were sampled during the field investigation. Most of the trees within these areas have been timbered and the existing shrub and herbaceous vegetation appears to represent approximately 3 years of regrowth. The clear-cut areas that were sampled contain both hydric and non-hydric plant species, and represent mesic vegetative communities that are characterized by soils, vegetation, and hydrology that are neither distinctly upland or wetland.

The canopies of the clear-cut areas that were sampled are composed primarily of loblolly pine (*Pinus taeda*) and provide very low vegetative cover (average = 2 percent) and basal area (average = 10 ft^2/acre). The subcanopy (shrubs and saplings) of the clear-cut association provides relatively high vegetative cover (average = 81 percent) and species diversity (average = 9 species). Dominant subcanopy species within this association include loblolly pine, red bay (*Persea borbonia*), gallberry (*Ilex glabra*), and highbush blueberry (*Vaccinium corymbosum*). The clear-cut areas that were sampled have an average ground cover of approximately 74 percent and an average herbaceous species diversity of about six species. Dominant herbaceous species that occur within the clear-cut association include broomsedge (*Andropogon virginicus*), panic grass (*Panicum* sp.), and seedlings of the shrub species.

Pine Flatwoods

Two pine flatwoods communities within the headwaters region of Cogdel's Creek were sampled during the field investigation. The pine flatwoods association is characterized by a relatively even distribution of longleaf pine (*Pinus palustris*) with a relatively sparse understory of subcanopy and herbaceous species. The upland communities offer relatively high-quality wildlife habitat to a variety of wildlife species including the red-cockaded woodpecker, which is federally listed as endangered.

The canopies of the pine flatwoods communities that were sampled are dominated exclusively by mid-age longleaf pine which provide relatively low vegetative cover (average = 10 percent) and basal area (average = 23 ft^2/acre). The subcanopy provides a vegetative cover of approximately 29 percent, has a species diversity of about seven species, and is of relatively low height, most likely as a result of controlled burning that is periodically conducted in these systems. Dominant subcanopy species within the pine flatwoods association include gallberry, pine saplings, and oak saplings. The herbaceous strata provide a vegetative cover of approximately 39 percent and have a species diversity of about eight species. Most of the ground cover within the flatwoods association is represented by wire grass (*Aristida* spp.).

Shrub Wetlands and Open Fields

One shrub wetland and one open field within the headwaters region of Cogdel's Creek were sampled during the field investigation. The shrub wetland and open field that were sampled are typical of other respective systems in the watershed. Shrub wetlands are wetland communities that are composed primarily of shrubs and saplings, and have minimal canopy cover. The on-base open fields typically have a high diversity of herbaceous plant species and minimal canopy and subcanopy cover. Because shrub wetlands have negligible areal coverage within the watershed, they are not shown on Figure 3.

The shrub wetland that was sampled is located between an upland pine flatwoods system and a mixed-forested wetland system, providing a relatively narrow transitional zone between the two communities. The canopy of the shrub wetland is very sparse, providing low vegetative cover and tree species diversity. Shrub and sapling species constitute most of the vegetative cover (95 percent) and species diversity (7 species) within the community. Dominant subcanopy species include fetterbush (*Lyonia lucida*), swamp bay (*Persea palustris*), red maple (*Acer rubrum*), and red bay. The herbaceous strata of the shrub wetland provide a vegetative cover of approximately 42 percent and contain about four species.

The open field that was sampled is composed exclusively of herbaceous vegetation. The field has a herbaceous vegetative cover of approximately 60 percent and a species diversity of about 23 species. The dominant herbaceous species in the field include broomsedge, panic grass, and various sedges.

Mixed Wetland Forest

One mixed wetland forest in the headwaters region and one mixed wetland forest in the middle-reach region of Cogdel's Creek were sampled during the field investigation. High canopy cover and relatively low subcanopy and ground cover characterize these communities.

The canopies of the mixed wetland forest communities that were sampled are composed of a variety of tree species that provide relatively high vegetative cover (average = 80 percent), basal area (average = 66 ft^2/acre), and species diversity (average = 5 species). Dominant canopy species in these communities include wax myrtle (*Myrica cerifera*), sweet gum (*Liquidambar styraciflua*), titi (*Cyrilla racemiflora*), red maple, and loblolly pine. The typical subcanopy of these systems provides a vegetative cover of approximately 34 percent and has a species diversity of about 6 species. Dominant subcanopy species within this association are primarily saplings of the canopy species. Herbaceous cover and species diversity within this association are both relatively low.

Mixed Upland Forests

Three mixed upland forest communities within the middle reach of Cogdel's Creek were sampled during the field investigation. Moderate canopy cover, high subcanopy cover, and sparse ground cover characterize this vegetative association.

The canopies of the mixed upland forest communities that were sampled are composed of a variety of tree species which provide moderate vegetative cover (average = 58 percent), high basal area (average = 113 ft^2/acre), and moderate species diversity (average = 4 species). Dominant canopy species in this association include southern red oak (*Quercus falcata*), sweet gum, loblolly pine, and water oak (*Quercus nigra*). Shrubs and saplings within this association constitute most of the vegetative cover (average = 79 percent) and species diversity (average = 9 species). Dominant subcanopy species include wax myrtle, highbush blueberry, horse sugar (*Symplocus tinctoria*), and saplings of the canopy species. The herbaceous cover and species diversity of this association are both relatively low.

Floodplain Swamp

One floodplain swamp within the middle reach of Cogdel's Creek was sampled during the field investigation. Most of the middle reach of Cogdel's Creek has a relatively broad floodplain that sharply transitions into steep topographic relief on both sides. The swamp that was sampled has moderate canopy cover, very low subcanopy cover, and high

herbaceous cover. All or most of this vegetative community may be periodically flooded throughout the year.

The floodplain swamp that was sampled has a canopy closure of approximately 40 percent, a basal area of approximately 87 ft^2/acre, and is composed primarily of black gum (*Nyssa sylvatica*) and Carolina ash (*Fraxinus caroliniana*). The subcanopy of this association is very sparse, providing only 2 percent vegetative cover. Subcanopy species include Carolina ash and ironwood (*Carpinus caroliniana*). All of the ironwood saplings within the plot that was sampled were dead, suggesting that the floodplain has undergone prolonged inundation, possibly as a result of channel flow restrictions and subsequent ponding of adjacent areas. Discussion on how the sampling data and other field observations correlate to impacts associated with sediment input and channel flow restrictions is provided in the Erosion/Sedimentation Impacts section. The floodplain swamp community that was sampled provides high ground cover (average = 91 percent) and moderate species diversity (average = 5 species). Bur-reed (*Sparganium* sp.) constitutes most of the herbaceous cover (80 percent) within the area that was sampled.

Floodplain Marsh

Three floodplain marsh communities within the downstream portions of Cogdel's Creek were sampled during the field investigation. Relatively low canopy and subcanopy cover and species diversity, and relatively high herbaceous cover and species diversity, characterize the downstream marsh associations. The floodplain marsh community occurs throughout many portions of the creek channel and is inundated throughout most or all of the year.

The floodplain marshes that were sampled provide low canopy cover (average = 17 percent), basal area (average = 26 ft^2/acre), and trees species diversity (average = 2 species). The dominant canopy species in these communities include black willow (*Salix nigra*), sweetgum, and wax myrtle. The subcanopy of these communities also provide low vegetative cover (average = 26 percent) and species diversity (average = 3 species). The subcanopy strata are composed primarily of saplings of the canopy species. The herbaceous strata within the floodplain marsh systems that were sampled provide relatively high vegetative cover (average = 83 percent) and species diversity (average = 5 species). Dominant herbaceous species in this association include smartweed (*Polygonum hydropipiroides*), bog hemp (*Boehmeria cylindrica*), rice cutgrass (*Leersia oryzoides*), soft rush (*Juncus effusus*), and alligator weed (*Alternanthera philoxeroides*).

Community Comparisons

The species composition and cover of certain vegetative associations in the Cogdel's Creek watershed were compared to respectively similar associations within the Duck Creek watershed to determine if the vegetative community structure of the Cogdel's Creek watershed differs significantly from that of an undisturbed system.

In general, there are no significant differences in vegetative species composition and cover between the two watersheds with respect to upland vegetative communities. Sedimentation/erosion or other base-related impacts to the creek system are not expected to directly affect upland vegetative associations within the Cogdel's Creek watershed.

The clear-cut and pine flatwoods associations were selected as the upland communities to be compared between the watersheds. The watersheds were not compared with respect to

the mixed upland forest association. The clear-cut and pine flatwoods associations are relatively similar between the watersheds with respect to strata vegetative cover, species diversity, basal area, and general community profile. There are no significant differences between the watersheds with respect to the community structure of these associations, nor are there any obvious signs of indirect disturbance to these systems from base-related activities that directly impact the creek system, such as sediment input and flow restrictions.

Significant differences do exist between the two watersheds with respect to certain wetland vegetative communities. The most notable differences between the watersheds occur among the floodplain swamp and marsh associations. The floodplain swamp and marsh communities that were assessed in the Cogdel's Creek watershed differ significantly in species composition, vegetative cover, and hydrological characteristics from respectively similar systems in the Duck Creek watershed.

The floodplain swamp and marsh communities in the Cogdel's Creek watershed hold more standing water than their counterparts in the Duck Creek watershed. Greater inundation of the floodplain areas of Cogdel's Creek are likely a result of sediment input, culvert blockages, beaver dams, and other flow restrictions caused by base-related activities. Consequently, the increased flooding that has occurred in portions of the Cogdel's Creek watershed has altered the vegetative structure of certain wetland communities. The most obvious signs of base-related impacts to wetland vegetative communities in the Cogdel's Creek watershed have been changes in the species composition and cover of certain strata, the prevalence of specific indicator plant species, and the relatively high number of dead or severely stressed canopy and subcanopy species. Each of these distinguishing characteristics is discussed in the Erosion/Sedimentation Impacts section.

Soils

According to the Soil Survey of Camp Lejeune (December 1984), the land area found in the Camp Lejeune area originated in a marine or coastal environment similar to that along the present Atlantic Coast. Changes in sea level due to glacial period fluctuations and/or slight earth crust plate movements have caused the alternating emergence and submergence of portions of this coastal area. Each successive sea-level fluctuation has resulted in shoreline modifications along the area.

This area of the Coastal Plain is underlain by hundreds of feet of unconsolidated to weakly consolidated sediments ranging from the Cretaceous to Miocene age. Generally, these formations are covered with a 5 to 30 feet thick layer of Pleistocene sediments made up of mostly clean sand and clayey sand inter-bedded with deposits of clay and marine shells.

Most of Camp Lejeune is nearly level with wide, undissected divides. These upland areas have minimal relief and have slow water movement. These soils are typically somewhat poorly or poorer drained due to the lack of slope for water to move or runoff the area.

The soils are relatively straightforward in the Cogdel's Creek watershed. Specifically, the Soil Conservation Service has mapped the poorly drained Muckalee loam series along the streams. The well-drained Marvyn soil series, with 6-15 percent slopes, was mapped along the side slopes near drainageways. The well-drained Baymeade soil series with 0-6 percent slopes were mapped adjacent to the side slopes in the upland position. The same mapped soils are found in similar landscape positions in the Duck Creek watershed.

Several other soils where identified and mapped within the Cogdel's Creek watershed including the very poorly drained Torhunta fine sandy loam found in uplands, the somewhat poorly to moderately well drained Onslow loamy fine sand, and the excessively drained Kureb fine sand, which has 1-6 percent slopes. Official descriptions of the previously mentioned series are located in Attachment A. Figure 4 shows soil types in the Cogdel's Creek watershed.

In general, the soils are sandy in texture, are moderate to rapid in permeability unless located in low topographic positions or have a limiting layer or subsurface horizon that slows water movement. Typically these soils have slight erosion hazards since water infiltrates rapidly into the sands rather than move along the surface of the soil. However, when natural or planted vegetation is disturbed, sand sized particles can become susceptible to wind erosion or can be dislodged by heavy rainfall events. The heavy tracked military equipment that is used for training at the base appears to disturb and kill vegetation and leaves some areas very susceptible to erosion as evidenced in the tank training areas located within the Cogdel's Creek watershed.

Camp Lejeune's climate is warm and humid. The summers are long and hot, while the winters are relatively short and mild. Abundant rainfall and warm temperatures promote rapid decomposition of organic matter and speed chemical reactions in the soil. The leaching of soluble bases and the translocation of less soluble fine particles in the soil profile are all hastened in this climate. The soils formed in this environment are typically acid, strongly leached of soluble bases like calcium and are low in natural fertility. The soils have higher clay content in the B horizon than in the A or C horizons except for soils that formed in sand or recent alluvium.

An investigation was conducted to examine the soils located within the Cogdel's Creek watershed by a certified professional soil scientist to assist in the assessment of the watershed. Additional soil investigations occurred in the Duck Creek watershed for comparison of soil characteristics between the two watersheds. The Duck Creek watershed is relatively undisturbed in comparison to the heavily impacted Codgel's Creek. The field study was conducted during October 26 - 29, 1997.

Soils characteristics were examined in several locations throughout Cogdel's Creek and Duck Creek. Soils profiles were exposed using shovels and hand augers. Locations (soil stops) are shown in Figure 5, and observations are included in Table 2.

Many of the stops have soils that are different from what has been mapped by the SCS. Due to soil's natural variability and the mapping scale necessary to delineate soils, there will be small, scattered areas of different soils that lie within any delineated map unit, unless the soils are extremely uniform. Unless map units are in extreme error, or the survey is dated, it is typically not necessary to re-map or change map units. No evidence observed from soil stops in this study would indicate that any type of re-mapping or more intensive mapping is necessary in this watershed, unless site specific activities are planned where more detailed soils information would be necessary.

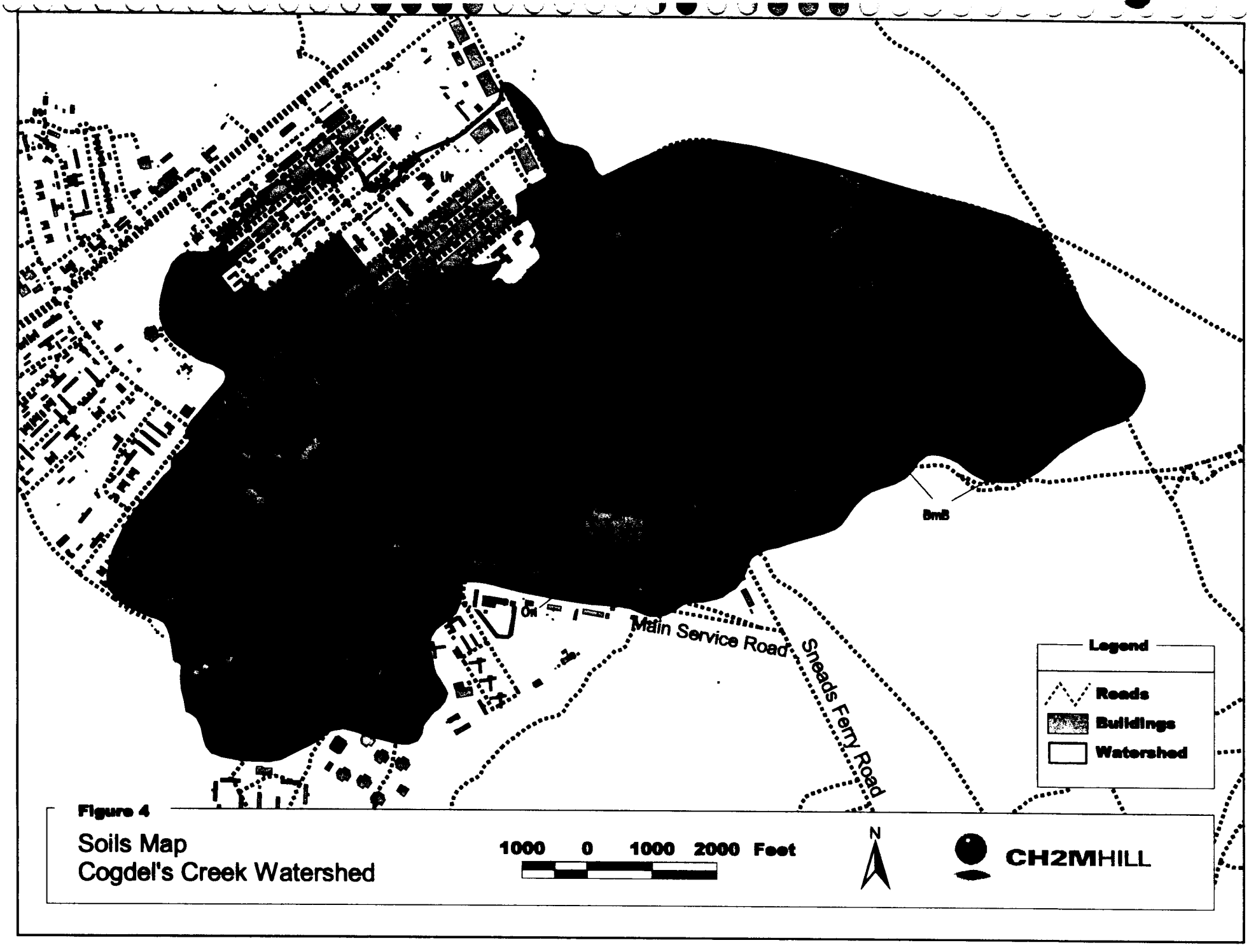


Figure 4

Soils Map
Cogdel's Creek Watershed

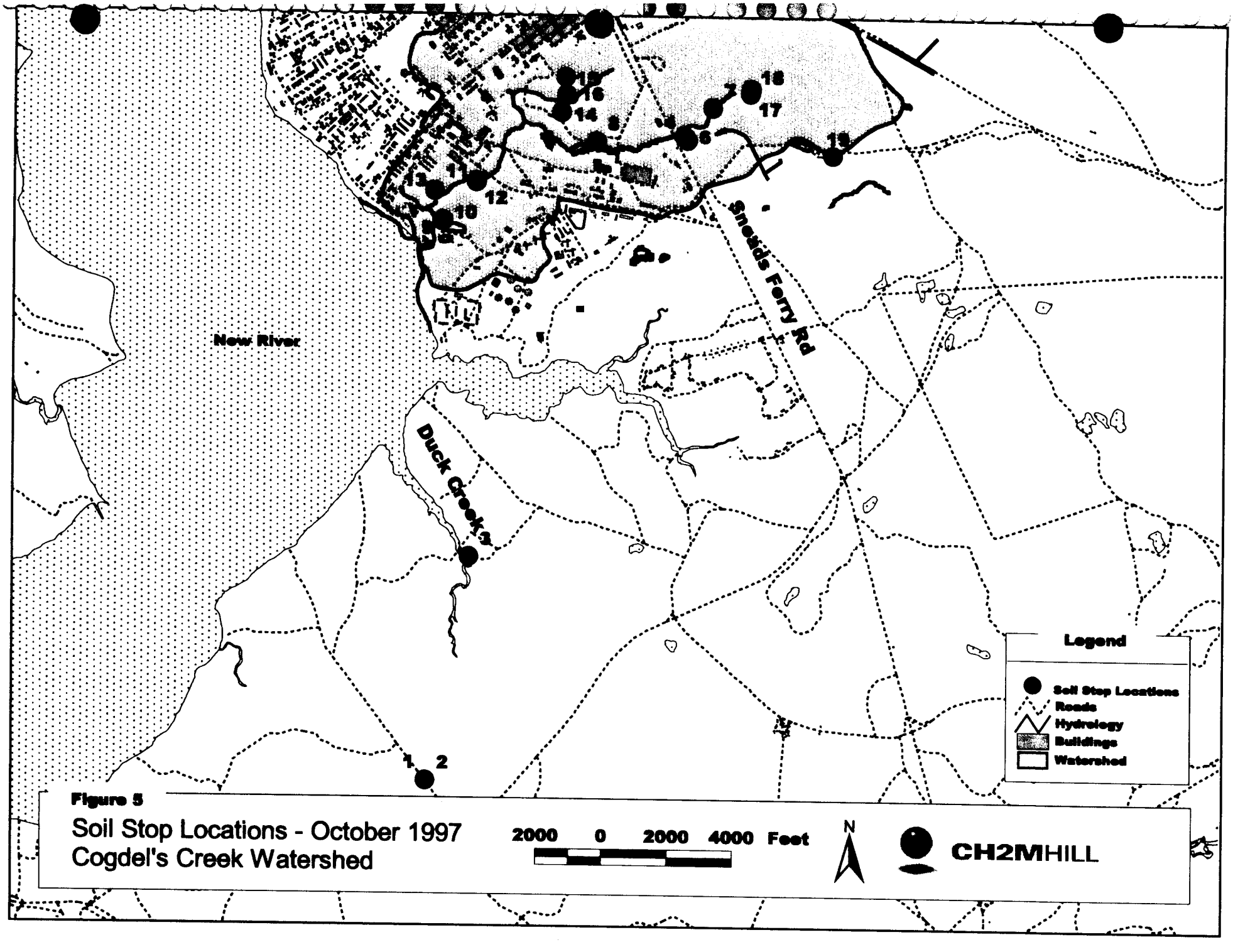


Figure 5

Soil Stop Locations - October 1997
Cogdel's Creek Watershed

Table 2. Soil Stop Descriptions
Cogdel's Creek and Duck Creek Watersheds

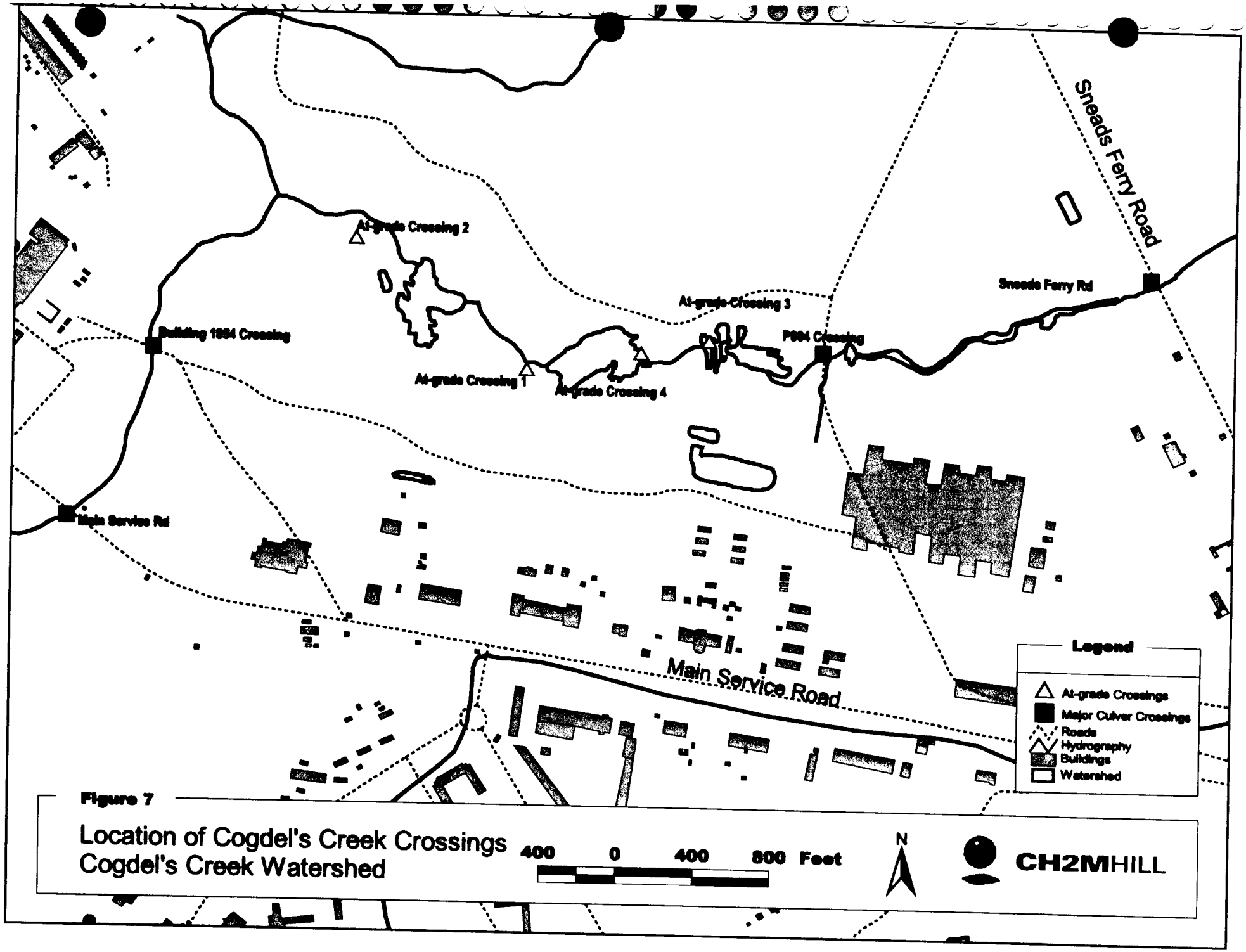
Soil Stop [1]	Watershed	SCS Mapped Soil [2]	Description
1	Duck Creek	Muckalee	This particular area of the floodplain had accumulated at least 6" of muck and as such is to wet to be considered a Muckalee series but would likely be the very poorly drained Dorovan muck.
2	Duck Creek	Marvyn	Side slope appears to fit well in the series descriptions.
3	Duck Creek	Marvyn	Located along a road cut in an upland position. Soil shows an excellent example of this soil series.
4	Cogdel's Creek	Muckalee	Located northeast of Road 172 in floodplain. Dense vegetation in the floodplain.
5	Cogdel's Creek	Marvyn	Located upslope from 4. SCS mapped as Marvyn but is poorly drained from lateral water flow down slope into area. Seepage areas near the lower edge of side-slopes will often exhibit wetland plants and hydric soils like this spot. Usually very localized area.
6	Cogdel's Creek	Marvyn	Well drained soil.
7	Cogdel's Creek	Baymeade	Soil appears to be moderately well to well drained upslope from creek. Soil in floodplain is mucky textured while water has duckweed .
8	Cogdel's Creek	Marvyn	Located next to a tank trail. Well drained. The adjacent roadway is approximated 2 feet deeper than small treed island where soil was examined. Trails show damage from compaction, disturbance of vegetation, and subsequent erosion.
9	Cogdel's Creek	Marvyn	Site next to tributary drainage-way. Vegetation is thick in lower floodplain area.
10	Cogdel's Creek	Marvyn	Located upslope from stop 9. Appears to be better drained than more typical Marvyn soils found at stop 9.
11	Cogdel's Creek	Muckalee	Located in floodplain. Well-defined channel has clear water moving through. Area appears to have had little disturbance.
12	Cogdel's Creek	Marvyn	Located upslope from stop 11. Soil wetter that typical Marvyn. Likely from lateral flow down slope. Side-slope covered with large pine trees in what appears to be one of the more undisturbed areas in Cogdel's Creek. However, last major storm has caused some areas of forest to be severely damaged from tree throw.
13	Cogdel's Creek		Located near area of softball diamonds. Area very disturbed. Earth moved in over flood plain to build housing, recreation area. Stormwater from parking areas drain into this area of the creek. Ditches have been dug into floodplain to improve drainage of area.

Table 2. Soil Stop Descriptions
Cogdel's Creek and Duck Creek Watersheds

Soil Stop [1]	Watershed	SCS Mapped Soil [2]	Description
14	Cogdel's Creek		Stream seems to have been cleaned with what appears to be a blade on the front of a bulldozer in the recent past. Some evidence of sediments moving in creek bed channel.
15	Cogdel's Creek		Area lies between storage buildings and creek. Large gully erosion has occurred in area. Very large amount of soil has been lost from area.
16	Cogdel's Creek	Marvyn	Creek channel has been dredged in the past. Standing water in old road lying adjacent to the creek. Very disturbed area.
17	Cogdel's Creek	Marvyn	Located in poorly drained area next to ill-defined stream channel. Near headwaters of watershed.
18	Cogdel's Creek	Baymeade	Located in headwaters area of creek. Appears to be moderately well drained which is slightly wetter than typical description of Baymeade series.
19	Cogdel's Creek	Torhunta	Old ditch through area has likely dried area by removing standing water. Nearby old trail has 2 feet of standing water.

[1] Locations shown in Figure 5.

[2] As described in Attachment A.


Sneads Ferry Road
At-grade Crossing 2
At-grade Crossing 3
Sneads Ferry Rd
Building 1884 Crossing
P884 Crossing
At-grade Crossing 1
At-grade Crossing 4
Main Service Rd
Main Service Road
Legend
At-grade Crossings
Major Culver Crossings
Roads
Hydrography
Buildings
Watershed
Figure 7
Location of Cogdel's Creek Crossings
Cogdel's Creek Watershed
400 0 400 800 Feet
N
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Culvert Stream Crossings

Major culvert crossings in the Cogdel's Creek Watershed were evaluated for signs of erosion, sediment input, culvert damage/deterioration, and other disturbances to determine existing impacts to the creek and develop remediation strategies for the system. Information that was collected on each major culvert creek crossing included the type and size of the culvert(s), signs of structural damage/deterioration to the culvert, evidence of erosion at the crossing, the form and extent of sedimentation occurring at the crossing, and other forms of drainage problems. Data on certain physical characteristics of the creek, such as water flow, embankment and channel profiles, and soil/sediment type were also collected at the crossings. Aerial photographs of the watershed were evaluated as an additional method of assessing the extent of sedimentation and flow restrictions that exist in the vicinity of the crossings.

Data collected on the culvert crossings are presented in Table 3. Many of the major culvert crossings within the Cogdel's Creek watershed have erosion and sedimentation problems. Signs of erosion are evident in all but two of the crossings that were evaluated. Erosion primarily occurs at those crossings that do not have densely vegetated embankments and/or sufficient amounts of riprap to stabilize the embankment slopes around the culvert pipes. Erosion of unstabilized soil primarily occurs during storm events when soil off of embankments, adjacent jogging trails, or tank trails washes directly into the creek system. Sediment input via erosion causes sediment build-up to occur around the culvert mouth and often leads to the creation of sediment dams and/or point bars several feet downstream of the culvert.

Sediment input via point-source erosion at the culvert crossings is one of several forms of drainage problems that were sighted during the field investigation. Many of the culverts that were evaluated have sediment build-up directly within the pipes and large amounts of sediment accumulation immediately downstream of the culvert. The accumulation of wood, rubble and other debris within and immediately outside of some of the culverts also restrict flow at the crossings. Based on the field evidence, flow restriction resulting from the accumulation of sediment and other debris in the vicinity of the culverts is very prevalent within the Cogdel's Creek watershed.

Table 3. Major Culverts
Cogdel's Creek Watershed

Crossing Location	Culvert Features [1]	Culvert Conditions	Erosion Features	Sedimentation/Blockage Problems
Behind Bldg 1118	36" RCP within wingwall	Good	Minor erosion on sides	6" of sediment in pipe Rubble/debris pile extending 150' from culvert; large point bar at end of rubble line
	48" RCP within wingwall	Good	Minor erosion on sides	3" of sediment in pipe; large sediment pile outside of pipe Rubble/debris pile extending 150' from culvert; large point bar at end of rubble line
Pond by Bldg 1450	16" RCP with 30" splash block	Good	Minor erosion; little rip-rap	Low sediment build-up at mouth
	25" RCP with 46" splash block	Good	Severe erosion under pipe and on bank	Heavy sediment build-up at mouth
	44" RCP with 64" splash block and 10.8' x 5.4' flume	Good	Severe erosion around pipe	Moderate sediment build-up at mouth
	55" x 32"pop-off structure with two 3" inflows and two 18" outflows	Good	not applicable	Sediment dam at outfall blocking flow
Behind Blds 1785-1799	36" RCP	Good	Minor erosion around pipe; no rip-rap	Sediment dam 20' from pipe; no blockage in pipe

TABLE 3 (CONTINUED)
Major Culverts
Cogdel's Creek Watershed

Crossing Location	Culvert Features [1]	Culvert Conditions	Erosion Features	Sedimentation/Blockage Problems
Bld 1854 and Duncun Rd	2 CMPs (48", 30") within concrete wingwall	Both good	No erosion	Sediment/debris dam 35' from pipes
	30" CMP with 48" splash block	Good	Severe erosion with overland flow	Sediment/debris dam 15' from pipe
Main Service Rd and creek	Three 54" RCPs	Fair	Some erosion directly above pipes Sediment input on south side via trail and concrete plume	>50% blockage in both side pipes Flow mainly through middle pipe (30% blockage) Point bars on north side; no sediment dams
Behind Tank Maintenance Bld	Two 42" RCPs; concrete structures divert flow into pipes	One of the pipes is partially collapsed	Significant erosion off of tank trail directly into creek on both sides	No flow through collapsed pipe Little flow through other one
Tank crossing near P804	Two 60" RCPs	Both pipes submerged; conditions unknown	No erosion; heavy vegetation on both sides	Both pipes appear to be blocked; no observable flow Old beaver dam 30' upstream.
Sneads Ferry Rd.	Two 60" CMPs	Both pipes submerged; conditions unknown	No visible erosion	No observable flow through pipes; dense vegetation at pipe openings blocking flow
Bld 914 across Sneads Ferry	30" RCP out of 9' concrete wall	Good	Slope erosion of intersecting ditches	4" of sediment in pipe
Bld 914	18" RCP out of 9' concrete wall	Good	Some erosion around wall; overland flow	No obvious blockage at wall; connecting upflow drain is blocked

[1] Culvert sizes estimated from observations in cases where all of culvert was not visible or accessible.

At-Grade Stream Crossings

Four at-grade crossings (Figure 7) of Cogdel's Creek within the tank training area were evaluated in the field by assessing certain stream habitat parameters such as channel and embankment conditions. Information on physical characteristics, water quality, and base-related impacts for each at-grade crossing were recorded on field data sheets as supporting data for assessing habitat parameters. Aerial photographs of the watershed were also evaluated as an additional method of assessing the general condition of each crossing.

To determine the overall stream habitat quality of the at-grade crossings, several physical and ecological parameters were assessed for each crossing. Information on the parameters for the at-grade crossings is provided in Table 4. Some observations that were common to all sites are listed below:

- *Substrate components* — Sand and silt
- *Bank stability* — Moderately stable
- *Bank vegetative stability* — 50-79 percent of bank vegetated
- *Bottom substrate available cover* — Less than 10 percent of bottom has stable cover
- *Flow at rep. low flow* — 1-2 cubic feet per second
- *Pool/riffle, run/bend ratio* — Flat water
- *Aesthetics* — Common setting, not offensive

Table 4. Field Observations For At-Grade Crossings
Cogdel's Creek Watershed

Parameter	Crossing 1	Crossing 2	Crossing 3	Crossing 4
Surrounding Land Use	Forest	Forest	Base facilities, marsh	Base facilities, marsh
Water Quality	Clear	Slightly turbid; brown color	Very turbid; brown color	Opaque; tanic color
Local Watershed Erosion	Heavy erosion evident	Moderate erosion evident	Heavy erosion evident	Some erosion evident
Local Watershed Non-point Source	Obvious sources	Obvious sources	Obvious sources	Moderate sources
Streamside Cover	Shrubs	Trees	Trees	Trees and grasses
Lower Bank Channel Capacity	Inadequate; overbank flow common	Inadequate; overbank flow common	Inadequate; overbank flow common	Occasional overbank flow
Lower Bank Deposition	Moderate deposition	Heavy deposition	Heavy deposition	Some deposition

The at-grade crossings are relatively similar to one another with respect to the parameters that were evaluated. The overall physical and ecological characteristics observed at the at-grade crossings are relatively representative of the entire mid-reach portion of the creek system. The segment of the creek where the at-grade crossings are located has relatively slow flow, sandy benthic substrate, and steep upland embankments. There are obvious signs of erosion and sedimentation at each of the at-grade crossings that were evaluated.

Based on the physical and ecological characteristics observed in the field, the portion of the creek system where the at-grade crossings are located is considered to provide "fair" stream habitat quality. This habitat quality rating is a qualitative descriptor of the overall condition of the system relative to that observed at Duck Creek. Further discussion on base-related impacts that have occurred at the at-grade crossings is provided in the Erosion/Sedimentation Impacts section.

Erosion/Sedimentation Impacts

Vegetation

Several characteristics distinguish certain wetland communities such as the floodplain swamps and marshes of Cogdel's Creek from similar wetland associations within undisturbed watersheds that have not been impacted by base-related impacts such as sedimentation and other induced channel flow restrictions. One of the most distinguishing features of the Cogdel's Creek floodplain swamps is the high vegetative cover of the herbaceous strata. Due to the increased frequency and extent of inundation that occurs within the floodplain areas, a greater diversity of hydric herbaceous species have the opportunity to recruit into areas that historically have held less standing water. Consequently, the floodplain associations within the Cogdel's Creek watershed have a dense cover of herbs that can successfully propagate in flooded areas such as bur-reed and alligator weed. In general, restricted channel flow and the concomitant increase in inundation of the Cogdel's Creek floodplain appears to have increased the amount of emergent vegetation within the channel and floodplain of the creek system, leading to more marsh habitats and less floodplain forest and riverine habitats throughout the watershed.

Another distinguishing feature of the Cogdel's Creek floodplain associations is the prevalence of certain plant species that are indicators of stagnation and slow drawdown conditions. For example, duckweed (*Lemna* sp.), a small floating plant that occurs in sluggish or still waters, is common in many of the floodplain communities of Cogdel's Creek, indicating the lack of appreciable flow in these systems. Other plant species such as lizard's tail (*Saururus cernuus*), which occurs along the landward portions of the floodplain swamps that were sampled, indicates slow drawdown conditions are also common to these systems. Slow drawdown is the slow retreat of water after stormwater inflow from a flood event has stopped. The presence of lizard's tail and other field evidence indicates that flood waters retreat relatively slowly from the most landward portions of the floodplain due to restrictions in channel flow.

Lastly, there is a relatively high number of dead or dying trees within the floodplain vegetative communities of Cogdel's Creek. Most of the dead and stressed trees and saplings are not toppled which suggests that the condition stems from the high water levels and not from past hurricane damage. Within the floodplain swamp that was sampled in the middle reach of Cogdel's Creek, all of the ironwood trees and saplings within and in the vicinity of the plot were dead, suggesting that the floodplain has undergone prolonged inundation. Similar conditions were observed in the emergent marsh systems that were sampled, where many of the wax myrtle and black willow trees and saplings are inundated by 10 to 40 inches of standing water.

Base-related impacts such as sediment input, culvert blockages, and other factors that restrict channel flow have increased the frequency, duration, and extent of inundation within many portions of the Cogdel's Creek floodplain. Consequently, the vegetative structures of certain wetland communities, such as the floodplain swamp and floodplain marsh associations, have been altered as these systems gradually adapt to these hydrological changes.

The field evidence indicates that increased inundation in many portions of the watershed is causing certain communities to gradually evolve into structurally different communities that are better suited to the ambient hydrology. For example, forested communities that are undergoing excessive inundation as a result of flow restrictions may eventually be converted into emergent marsh communities through the gradual replacement of tree species with emergent species that are better-suited to higher water levels. In general, increased inundation appears to have resulted in increases in emergent marsh habitat and decreases in forested floodplain and riverine habitats within the Cogdel's Creek system. Such shifts in vegetative community structure have the potential to affect many functions of the watershed, such as nutrient filtration capacity, flood attenuation potential, and wetland/wildlife habitat.

At present, the observed impacts to the floodplain vegetative communities do not appear to be overwhelmingly detrimental to the watershed. However, ambient conditions suggest that if erosion is not stopped and flow restrictions are not alleviated the vegetative structure and function of certain floodplain communities will continue to change in response to the changing hydrology of the system. Increases in the frequency, duration, and extent of inundation in certain portions of the watershed have caused noticeable structural changes to certain wetland vegetative communities. In turn, the vegetative and hydrologic changes caused by sedimentation and other factors restricting flow have indirectly altered the physical appearance of the Cogdel's Creek system. The channel is less defined and the floodplain is wider in many areas, which changes the shape of the creek system in certain portions of the watershed.

Soils

In general, the area around and in Cogdel's Creek has been massively disturbed by man's activities even before Camp Lejeune was established. In contrast, the Duck Creek watershed has had little disturbance. The soils are basically similar in both watersheds with poorly drained soils in the floodplains, well-drained sandy soils on the side slopes, and level- poorer drained soils in the uplands. The notable exceptions are where disturbances, typically from large mechanized equipment, have caused vegetation disturbances and subsequent erosion to occur uncontrolled in some areas of the Cogdel's Creek watershed.

In the Cogdel's Creek watershed, some areas have been denuded of vegetation and allowed to erode. Loosened sand sediments from heavy military traffic trails have eroded, presumably into the creek. Culverts in the creek have trapped sediments behind them and caused water levels to rise in some areas and over time make some of the floodplain soils more poorly drained. Higher water levels may also be caused by vegetation and beaver activity. Areas were noted where trees were dying from what appeared to be relatively recent inundation of the soils. As sediments have clogged the creek, ditches have been dredged in some areas to help drain and keep the water moving through the creek. It also

is probable that at tank crossing areas that sand has been added to allow other vehicular traffic to cross the stream.

It was noted that in some tank trails that the current level of the trail could be as much as several feet lower than the surrounding undisturbed areas. Besides the potential wind and water erosion of the sand particles loosened by the tracks, severe soil compaction has likely occurred over the years. These compacted trails that are rutted and lower than surrounding natural soil often contain ponded water. With the natural soil structure destroyed and porosity compacted from large equipment they typically hold water until evaporation dries the low spots.

Stream Channel

Hydrology and Channel Elevations

The deposition of sediment at culvert and at-grade crossings is addressed in the following subsections. In general, impacts in the creek channel are limited to sedimentation; there was no in-channel erosion observed. One effect of the sedimentation is to mask any potential impacts on the channel stability upstream, since clogged culverts increase flow attenuation.

The stream channel is generally a dynamic watershed feature reacting to climatic changes and to changing land use patterns within the watershed. In balance, the channel will form so as to have enough capacity to convey frequent storm flows from the watershed and have reserve capacity to attenuate and deliver flood flows. Sediment delivery of the stream channel will also change in response to climatic and watershed conditions. At equilibrium, the stream will deliver a sediment load about equal to the amount of sediment delivered to the stream channel.

The Cogdel's Creek watershed in recent history has undergone significant development. This has caused physical changes to the stream channel as well as an increased sediment load to the stream. The physical changes to the stream such as at grade crossings and culvert crossings appear to have attenuated flows. This results in slower velocities and a decreased ability to carry sediment. The combination of an increased sediment load and reduced sediment delivery capacity has been a significant accumulation of sediment in the stream channel.

In order to estimate the total amount of sedimentation in Codgel's Creek, a hand auger was used to assess the depth of sediment at strategic locations. Figure 8 shows the locations where sediment depths were evaluated, and Table 5 summarizes the field observations. Using the field observations, along with the information in Figure 9 (based on topographic mapping and culvert inverts), cross sections were plotted for Site 14 (at-grade crossing 2) and Site 15 (at-grade crossing 1). Sketches of the cross sections are shown in Attachment B.

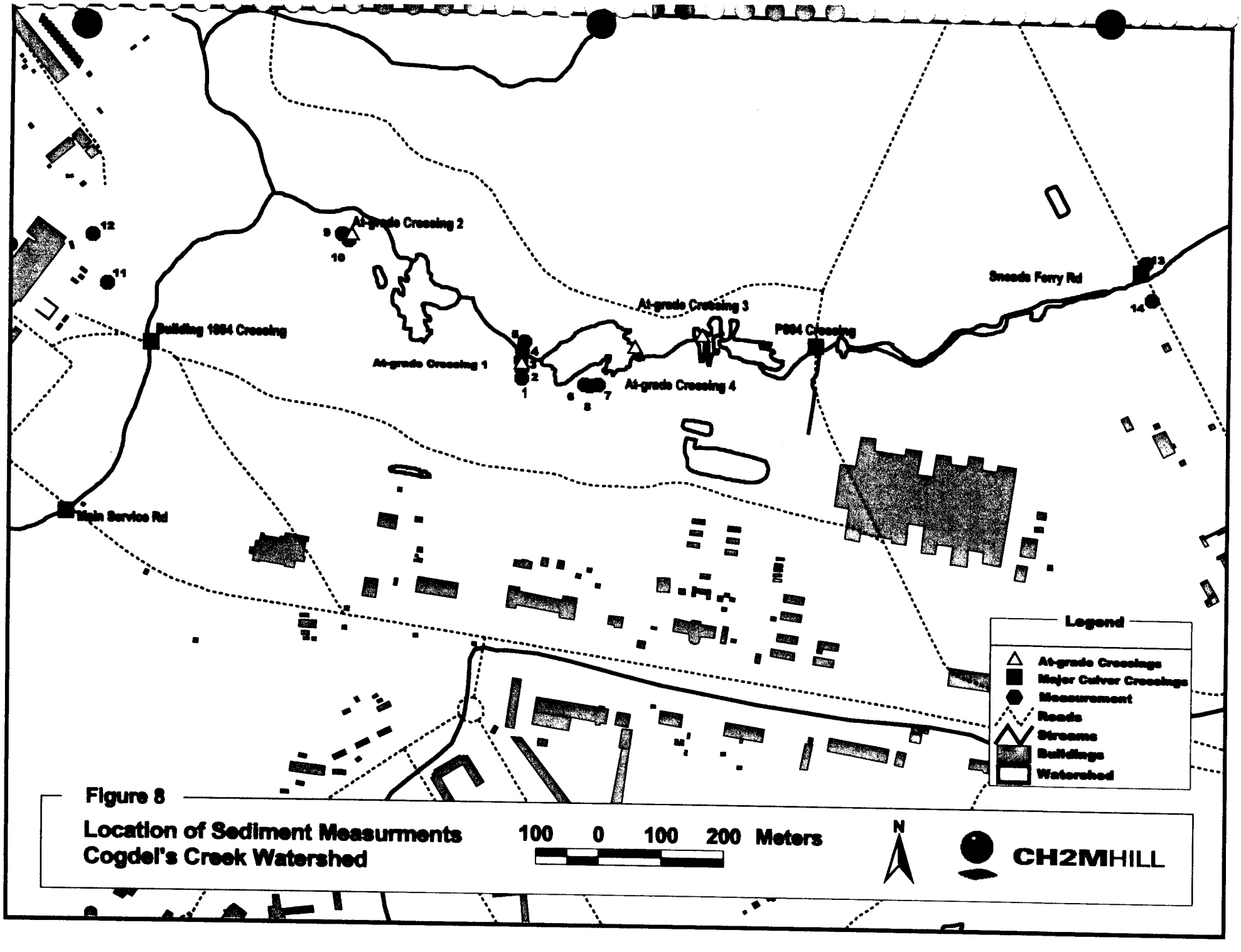


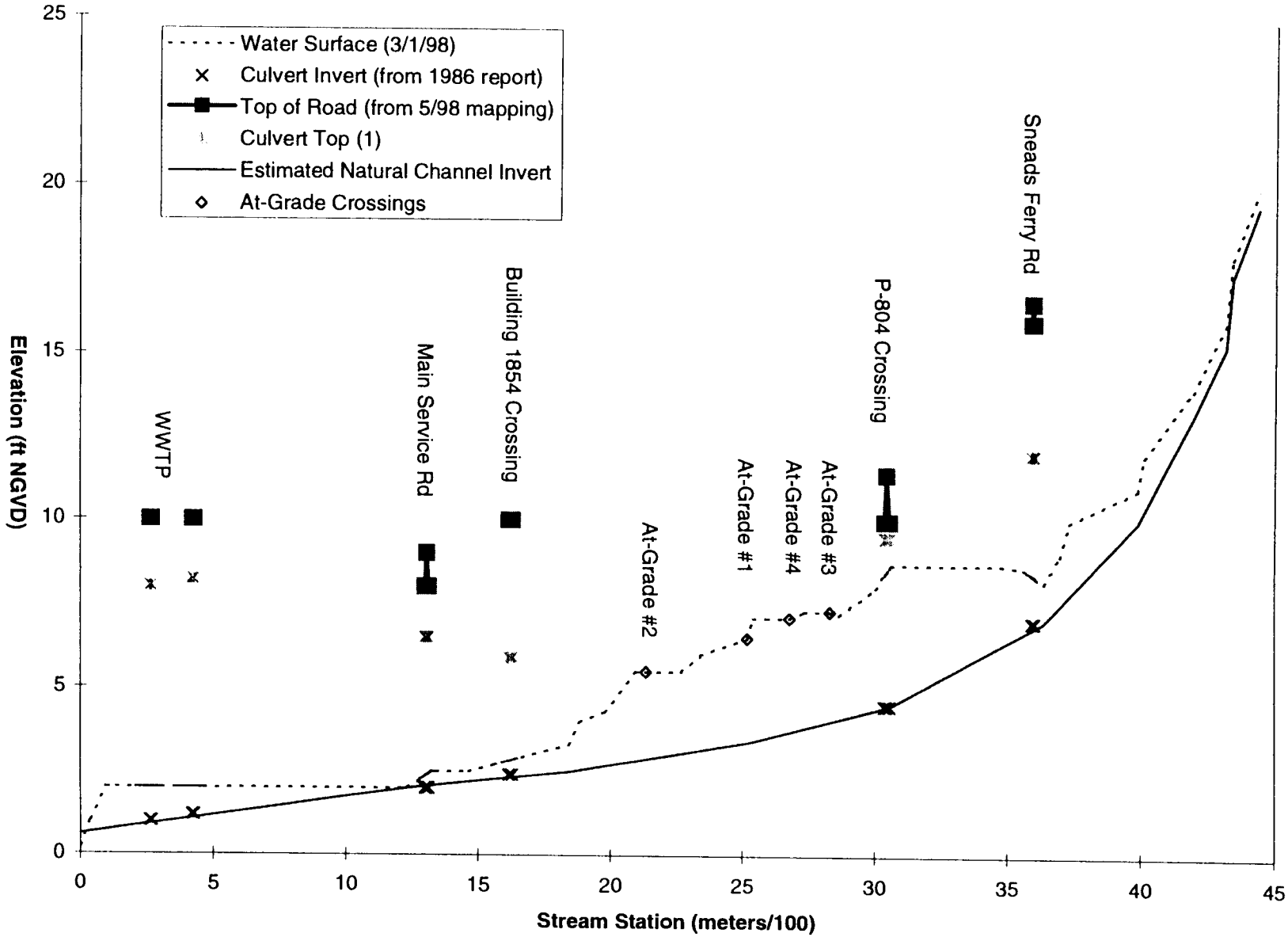
Figure 8

Location of Sediment Measurments
Cogdel's Creek Watershed

Location	Length (ft)	Width (ft)	Depth (ft)	Volume (ft^3)	Volume (CY)	Position	Figure 1 ID [1]	Approximate Distance From Stream Centerline	Depth to Water	Observations
Site 15	800	30	1.3	31200	1156	At Grade Crossing 1	1	100 feet south	14"	White to gray sand @ 16"
						At Grade Crossing 1	2	50 feet south	7"	White sandy soil with a slight indication of black (organic) @7"
						At Grade Crossing 1	3	Centerline	0	Center line of stream
						At Grade Crossing 1	4	50 feet north	NA	Organic soil (& roots) @ 8"
						At Grade Crossing 1	5	100 feet north	NA	Gray to brown transition @ 30"
Site 16	350	30	2.1	22050	817	At Grade Crossing 4	6	100 feet south	14"	White sand to Water
						At Grade Crossing 4	7	100 feet south	8"	White sand to Water
						At Grade Crossing 4	8	100 feet south	6"	White sand to Water
Site 14	700	30	0.8	16800	622	At Grade Crossing 2	9	100 feet south	4"	White sand to dark gray sand @ 2"
										Dark gray to water @ 4"
						At Grade Crossing 2	10	100 feet south	NA	White sand to light gray sand @ 8"
										light gray sand to dark gray sand @ 24"
										Dark gray sand to organic sand/soil @ 32"
Site 13	500	30	0.8	12000	444	Sneads Ferry Rd	13	100 feet north	14"	Top soil to dark gray sand @ 2",
										Dark gray sand to med gray sand @ 10"
										med gray sand to water @14"
						Sneads Ferry Rd	14	200 feet south	12"	White sand to dark gray/brown organic sandy/soil @ 10"
										dark gray/brown organic sandy/soil to water @ 12"

[1] ID numbers 11 and 12 were for checking culvert characteristics.

Table 5
Sediment Measurement Observations



(1) Culvert top is based on invert and size.

Figure 9
Cogdel's Creek Estimated Natural Profile

Because observations were limited at Sites 13 and 14, results from Site 15 were used for this section. Site 15 observations resulted in the most complete cross section. Table 6 shows the resulting cross-sectional sediment areas, lengths between sections, and total sediment volumes. The length of stream between Building 1854 (Site 10) and Sneads Ferry Road appears to have the bulk of the sedimentation, which is consistent with earlier observations about significant sources of sediment from disturbance in that area. The resulting total sediment volume between the Building 1854 crossing and Sneads Ferry Road is about 44,000 cubic yards. Based on the topographic maps and observations at specific project sites, it appears that the sediment has eroded mostly from tank trails and developed areas to the south of Cogdel's Creek.

Table 6. Sediment Volume Estimates
Cogdel's Creek Watershed

From	To	Length (feet)	Cross-sectional sediment area (square feet)	Sediment Volume (CY)
Site 10/Bldg 1854	Site 14/At-grade crossing 2	850 (halfway)	140	4,407
Site 14/At-grade crossing 2	Site 15/At-grade crossing 1	1260	140	6,533
Site 15/At-grade crossing 1	Site 16/At-grade crossing 4	520	254	4,892
Site 16/At-grade crossing 4	Site 17/At-grade crossing 3	500	254	4,704
Site 17/At-grade crossing 3	P804	700	254	6,585
P804	Sneads Ferry Rd	1810	254	17,027
Total		5,640		44,148

Note: From Site 10 to Site 15, cross-sectional area for Site 14 is used. From Site 15 to Sneads Ferry Road, cross-sectional area from Site 15 is used.

Culvert Stream Crossings

Blockage of the culverts by sediment and other debris impacts the creek system in many ways. For example, at two of the crossings that were evaluated, culvert blockage appears to have contributed to excessive inundation of the upstream floodplain, killing most of the tree species that are adapted to less inundated conditions. Most of the dead and stressed trees and saplings at these crossings are not toppled which suggests that the condition stems from the high water levels and not from past severe storm event and wind damage.

Certain plant species that are indicators of stagnation, such as duckweed, occur in high numbers at the crossings where flow is severely restricted, indicating the lack of appreciable flow in these portions of the creek system. Increases in the frequency, duration, and extent of inundation due to flow restrictions at some of the culvert crossings are causing certain

vegetative communities to gradually evolve into structurally different communities that are better suited to higher water levels. For example, forested communities that are undergoing excessive inundation as a result of flow restrictions may eventually be converted into emergent marsh communities through the gradual replacement of tree species with emergent species that are better-suited to higher water levels.

Restricted channel flow may also gradually increase the amount of vegetation within the channel and floodplain of the creek system, leading to more marsh habitats and less riverine habitats throughout the watershed. Shifts in vegetative community structure and increases in emergent marsh habitats have the potential to affect many functions of the watershed, such as nutrient filtration capacity, flood attenuation potential, and wetland/wildlife habitat.

Flow impediments throughout the creek system also have the potential to significantly alter the physical structure of the watershed. Slower flushing rates and increased inundation of the floodplain resulting from flow restrictions may gradually lead to changes in soil, water quality, and channel profiles. Slower flushing of riverine systems generally leads to decreased water quality resulting from less efficient removal of nutrients and pollutants and greater input and retention of organic matter and sediment. Increases in the extent and duration of inundation leads to changes in the soil profile of the floodplain, causing soils to gradually become more hydric in profile through time.

At present, the channel and floodplain of Cogdel's Creek differ in physical appearance from that of undisturbed systems such as Duck Creek, as an indirect result of the vegetative and hydrological changes that have been caused by sedimentation and other factors restricting flow. Increases in the extent of inundation within the floodplain of Cogdel's Creek appear to have widened the floodplain and made the channel less defined in many portions of the system. Increases in emergent marsh habitat and decreases in forested floodplain and riverine habitats within the Cogdel's Creek system also distinguish it in physical appearance from undisturbed watersheds such as Duck Creek.

At-Grade Stream Crossings

The at-grade crossings that were evaluated are regularly used as water crossings during tank training exercises and tank maintenance testing. During tank crossings, bottom sediments are suspended into the water column and transported downstream by creek currents. Embankment soils also erode into the creek and are also transported downstream.

The suspension of bottom sediments and erosion of embankment soils into the water column during the tank crossings generates large turbidity plumes at the crossings and ultimately impacts the water quality of a much greater area when the plume is transported downstream. The extent to which the turbidity plume is transported depends on the type of sediment/soil that is suspended in the water column. The bottom sediments and embankment soils at the at-grade crossings are a mixture of sand and silt. The larger grain sands will settle to the creek bottom faster and, therefore, will travel a shorter distance downstream than the silty material. The total distance that the turbidity plume will travel depends on the plume size, the percent composition of the plume material, and flow conditions of the creek.

Although sedimentation occurs during individual tank crossings, larger amounts of sediment are expected to enter the creek via erosion of the tank trails, and adjacent unpaved

high-traffic areas, during storm events. All of the at-grade crossings that were evaluated are part of tank trails that branch off of an open tank training/testing area that lies adjacent to Cogdel's Creek. The tank trails and open training area are composed entirely of sand. Erosion of sand primarily occurs off of the portions of the trails that slope toward the creek. Some erosion of sand also occurs off of the open training area and travels down the trail to the creek. At the locations evaluated the portions of the tank trails that slope toward the creek range from approximately 50 to 300 feet. During storm events, sand will erode off of these segments directly into the creek.

Identification and Prioritization of Problem Areas

Figure 10 shows problem areas, which are described in Table 7. In addition to the major culvert and at-grade crossings, the sites include several large upland areas that showed evidence of heavy erosion. While erosion was observed at smaller areas during the field investigation, these more typical problems will be addressed in the watershed management plan, rather than in the site-specific problems listed here. Table 8 provides a prioritization of the areas according to environmental sensitivity, importance of habitat, difficulty of remediation, and potential cost. The categories are described below.

Environmental Sensitivity

Low—No wetlands or other significant natural resource present at the site

Moderate—Resource present at the site that will require a permit, no significant problems obtaining permit are expected

High—Resource present at the site that will require a permit, significant mitigation will likely be required to obtain permit

Importance of Habitat

Low—Site provides little habitat or habitat for highly urbanized species.

Moderate—Site provides habitat for species common to the surrounding vegetative community.

High—Site provides habitat for protected, rare, or otherwise unique species.

Difficulty of Remediation

Low—Site conditions and remediation techniques are commonly used and require no special construction techniques.

Moderate—Site conditions and remediation techniques are common but require some special construction techniques.

High—Site conditions and remediation techniques are not common and require special construction techniques.

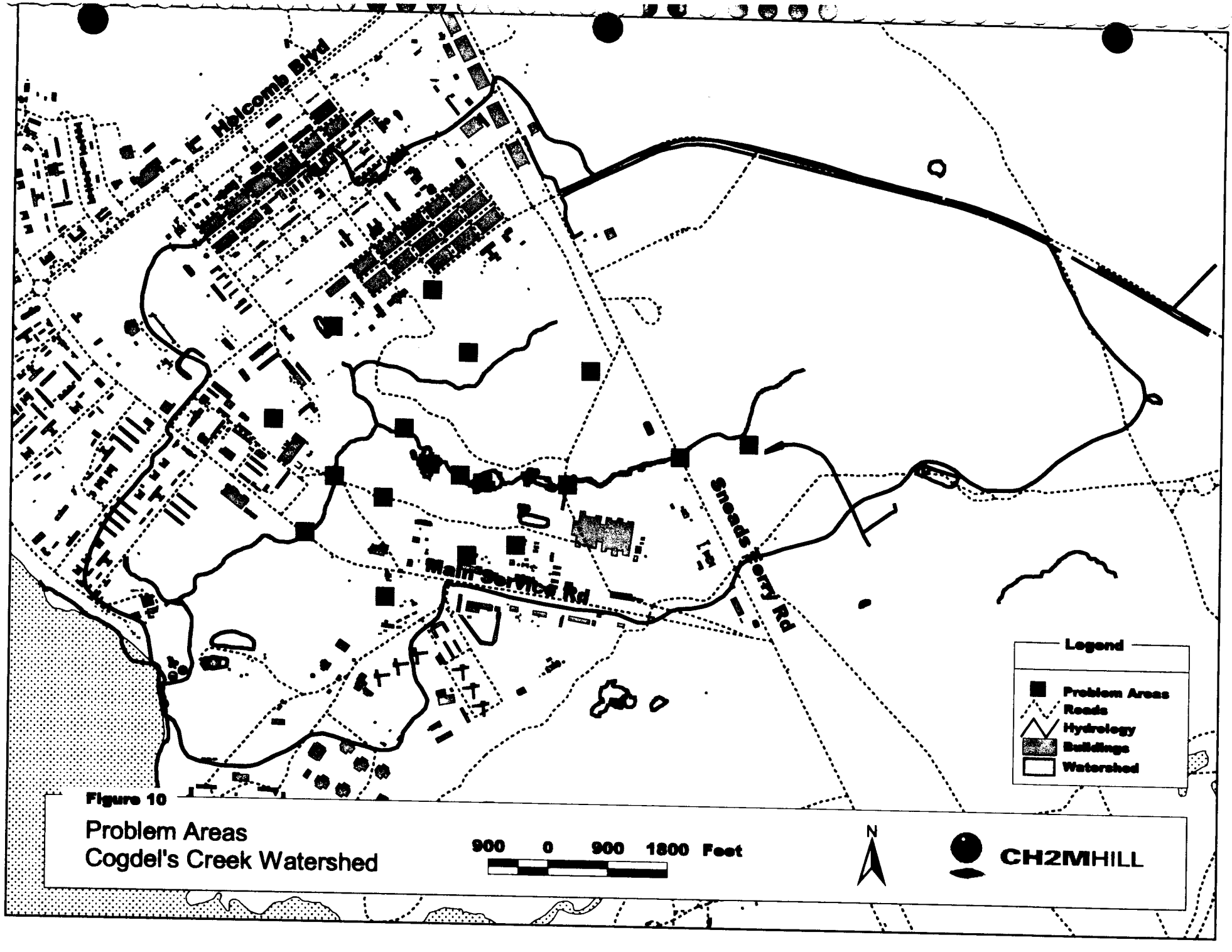


Figure 10

Problem Areas
Cogdel's Creek Watershed

Table 7. Problem Areas
Cogdel's Creek Watershed

Site No.	Description
1	GP816 Area: Large disturbed area with significant observed erosion into Cogdel's Creek tributary
2	Tank Trail Area: Trails provide source and direct conduit for erosion into Cogdel's Creek
3	FC-100 Area: Large disturbed area with heavy traffic; significant observed erosion into trail upstream of creek
4	FC-200 Area: Large disturbed area with heavy traffic; observed erosion
5	Landfill Area: Disturbed area just upstream of creek
6	Building 1775 Area: Large unpaved, unvegetated area adjacent to tributary
7	Building 1450 Area: Significant erosion observed at discharge pipes into pond; observed erosion from unpaved areas east of parking lot
8	MT/ENG Building Area: Outfalls from several heavy industrial areas, along with erosion from unpaved areas, go directly to tributary to creek
9	Fenced Area Near Sneads Ferry Road: Large unpaved area draining generally toward creek; ORRV trails provide conduit for erosion
10	Building 1854 Culvert Crossing: Severe culvert blockage and sedimentation in creek
11	Main Service Road Culvert Crossing: Almost 50% blockage in culverts
12	Building P-804 Culvert Crossing: Culverts almost completely blocked; evidence of road overtopping
13	Sneads Ferry Road Culvert Crossing: Culverts appear to be almost completely blocked
14	At-Grade Crossing 2: Severe disturbance from tanks driving through creek; berms formed in creek from tracking; heavy sedimentation
15	At-Grade Crossing 1: Severe disturbance from tanks driving through creek; berms formed in creek from tracking; heavy sedimentation; 800 feet of ditch dug adjacent to creek to improve flow
16	At-Grade Crossing 4: Disturbance from tanks driving through creek
17	At-Grade Crossing 3: Severe disturbance from tanks driving through creek; berms formed in creek from tracking; heavy sedimentation
18	ORRV Trail Crossings: Two crossings through tributary observed in field; potential for several more estimated from review of aerial photograph and area available; berms formed from tracking; heavy sedimentation at crossing

Table 8. Problem Area Prioritization
Cogdel's Creek Watershed

Site No.	Environmental Sensitivity	Importance of Habitat	Difficulty of Remediation	Potential for Erosion Control	Potential Cost	Overall Priority
1	Low	Low	Low	High	Moderate	High
2	Low	Low	Low	High	High	High
3	Low	Low	Low	High	Moderate	High
4	Low	Low	Low	High	High	High
5	Moderate	Low	Low	High	Low	High
6	Low	Low	Low	Moderate	Low	High
7	Low	Low	Low	Moderate	Moderate	Moderate
8	Low	Low	Low	Moderate	Moderate	Moderate
9	Low	Low	Low	High	Low	Moderate
10	Moderate	Moderate	Moderate/High	Low	Low-High	High
11	Moderate	Moderate	Moderate/High	Low	Low-Moderate	Moderate
12	Moderate	Moderate	Moderate/High	Low	Low-High	High
13	Moderate	Moderate	Moderate/High	Low	Low-Moderate	High
14	Moderate	Moderate	Moderate/High	Low	Low-Moderate	High
15	Moderate	Moderate	Moderate/High	Low	Low-Moderate	High
16	Moderate	Moderate	Moderate/High	Low	Low-Moderate	Moderate
17	Moderate	Moderate	Moderate/High	Low	Low-Moderate	High
18	Moderate	Moderate	Moderate	Low	Low	Moderate

Potential for Erosion Control

Low – Implementing recommendations will have a low reduction of sediment to the stream channel.

Moderate – Implementing recommendation will moderately reduce sediment load to the stream channel.

High – Implementing recommendation will significantly reduce sediment load to the stream channel.

Potential Cost

Low—Cost opinion between $0 and $100,000.

Moderate—Cost opinion between $100,000 and $1,000,000.

High—Cost opinion greater than $1,000,000.

Future Land Use

Future land use in the Cogdel's Creek watershed is not expected to change substantially. The activities that could have the most impact on Cogdel's Creek are construction, training, and recreation. Figure 11 shows planned construction in the watershed. As long as appropriate erosion control measures and peak flow attenuation are used during and after construction, the added impervious surface should not cause erosion problems. However, the reduction of sediment load as a result of this project may increase the potential for channel degradation in later years, by removing in-stream attenuation from blocked crossings.

Training in the Cogdel's Creek vicinity consists of tank maneuvering exercises related to tank maintenance. Discussions with MCB Camp Lejeune personnel indicate that driving through water is not needed for the tank maintenance activities. It is anticipated that tank maneuvering will be limited to an improved tank trail in the future, as described in the remediation alternative projects.

Currently, there are two areas with in the Cogdel's Creek watershed that are used by off-road recreational vehicles (ORRV). Both are identified as problem areas and included in the remediation alternatives. One is a series of trails on the north side of Cogdel's Creek, between the main creek and a tributary, directly north of FC-200. The other area is a motorcross area just southeast of the tank maintenance building (1854).

During discussions at in-progress review meetings for this project, MCB Camp Lejeune personnel have indicated that the ORRV areas will be temporarily closed while future use of the areas is considered. There is potential that both areas will be closed.

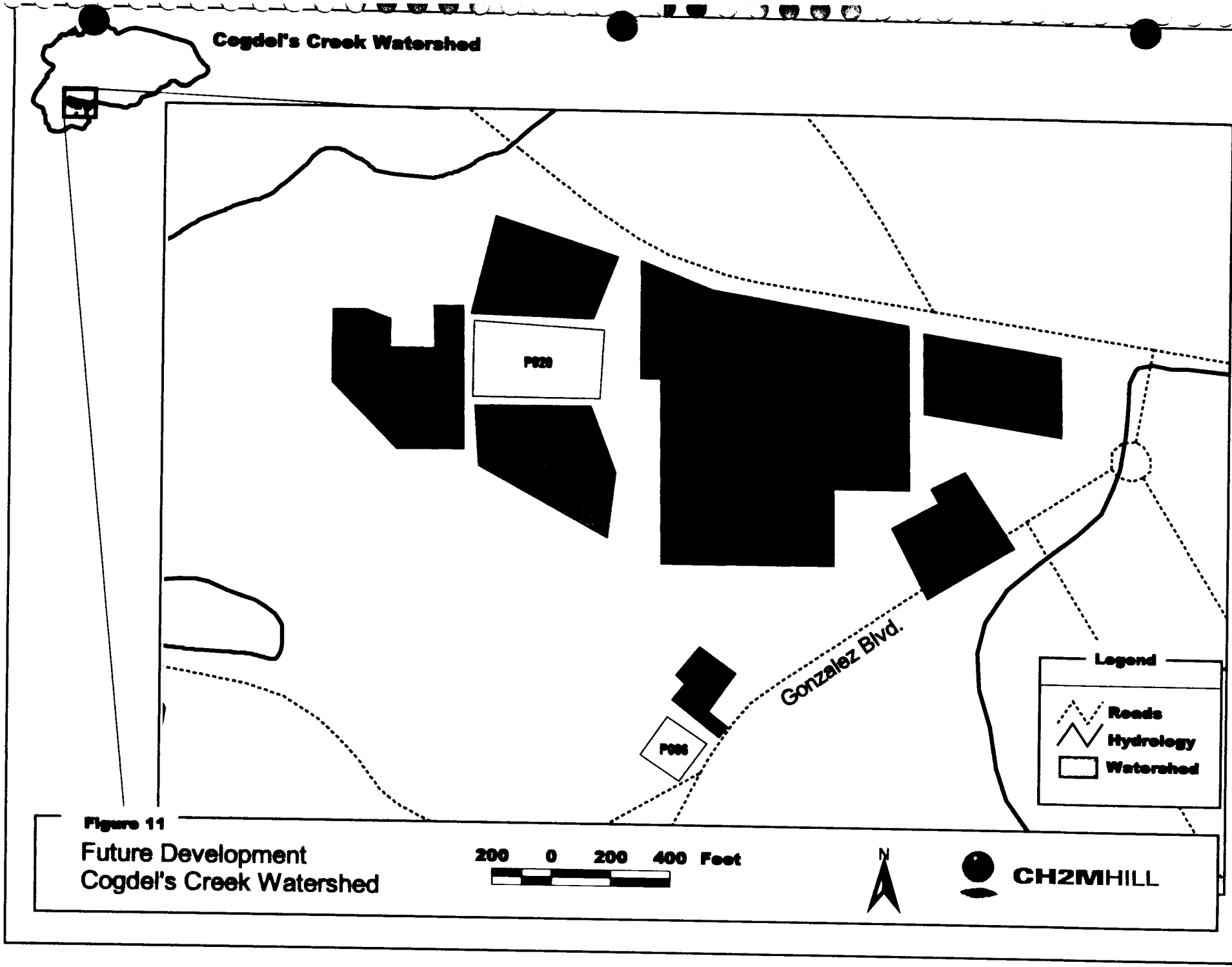


Figure 11

Future Development
Cogdel's Creek Watershed

Remediation Alternatives

Three alternatives were evaluated for addressing erosion and sedimentation problems in the Cogdel's Creek watershed:

1. No action
2. Erosion control with strategic creek channel restoration
3. Erosion control with comprehensive creek channel restoration

The second and third alternatives include the same measures for erosion control. However, restoration activities in the creek for the second alternative are limited to improving conveyance and restoring damage at creek crossings (culverts and at-grade). The third alternative is more comprehensive, including removal of sediment upstream of the crossings. Details of each alternative are discussed below, including costs and regulatory considerations.

Site-specific conceptual projects were developed as part of the alternatives evaluation, then were refined to develop the final remediation plan. Since there were very few changes, the site-specific projects are only presented in their final form in this report, in the following section (Remediation Plan). Figure 12 shows the project locations.

No Action (1)

Description

Under the no action alternative, erosion from upland high-traffic areas as well as bare areas adjacent to Cogdel's Creek would continue. The result would be continued sedimentation of the creek and its tributaries. The potential for flooding of adjacent developed areas will increase as storage volume in the floodplain and conveyance capacity of culverts continue to decrease. Under severe storm conditions, the reduction in conveyance of road crossing structures could cause overtopping and failure of the structure.

Vegetation upstream of stream crossings will continue to evolve from forested floodplain and riverine habitats to emergent marsh habitat. While this may not be viewed as entirely negative, it will increase regulatory complexity of future restoration efforts as jurisdictional wetlands expand.

Developed areas that currently experience severe erosion will need frequent grading in order to remain usable. The FC-200 area (Site 4) is a good example of use of this practice.

Regulatory Considerations

Under this alternative, it is likely that MCB Camp Lejeune activities will not be in conformance with the existing erosion/sedimentation plan. Regulatory scrutiny may lead to requirements for more fast-track erosion control projects similar to those proposed under the other two alternatives, and could possibly result in notices of violation.

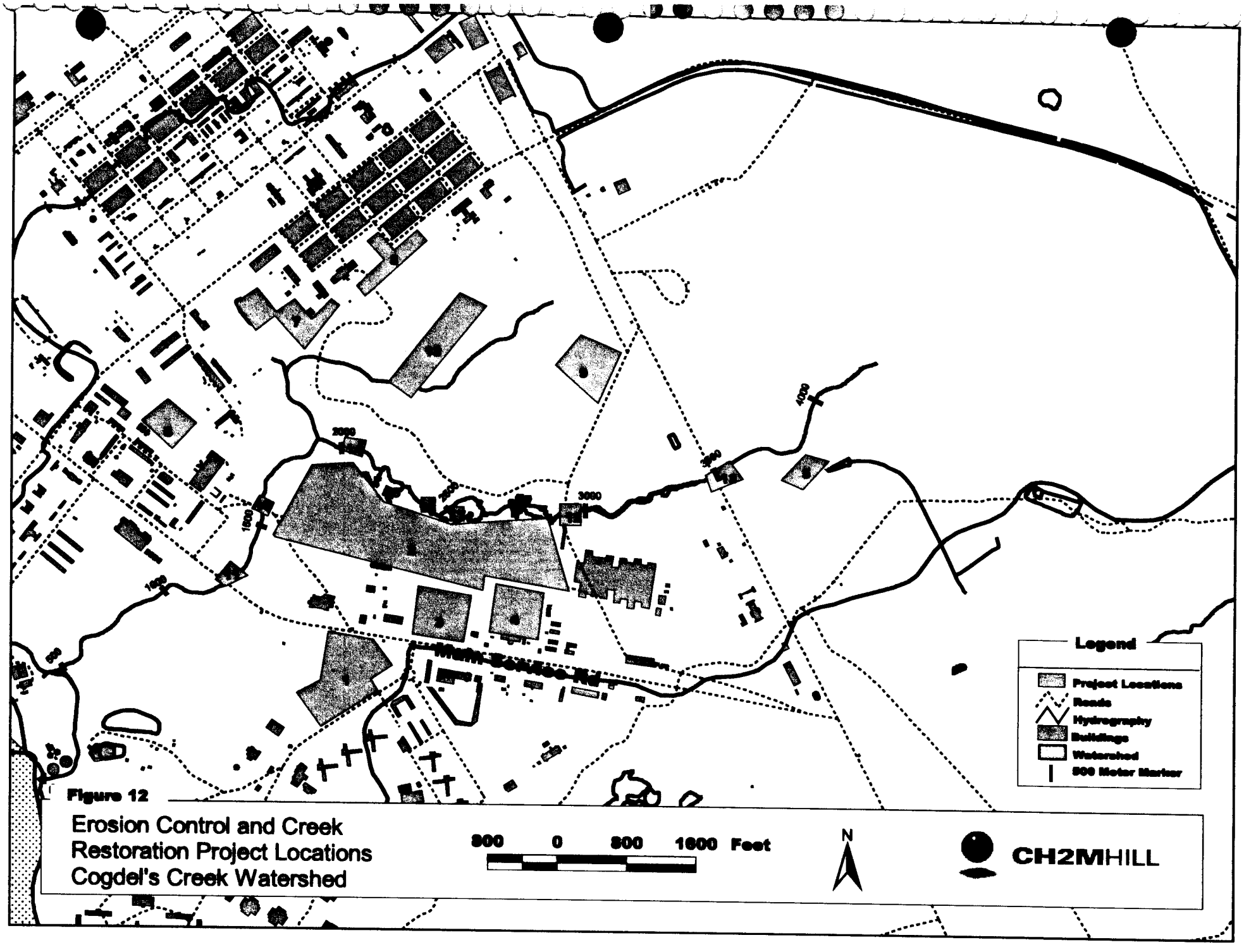


Figure 12

Erosion Control and Creek
Restoration Project Locations
Cogdel's Creek Watershed

Cost

There are no capital projects and associated costs proposed for this alternative. Costs for continual grading of high-erosion areas would be higher than for the other alternatives. As discussed under regulatory considerations, this alternative would probably lead to the forced implementation of portions of the other alternatives. Costs would be higher because of likely regulatory intervention and because problems will worsen, making solutions more expensive, as they go unchecked.

Erosion Control with Strategic Creek Channel Restoration (2)

Description

The first and most essential management technique for restoring Cogdel's Creek is to reduce the sediment delivered to the stream channel. The nature of sandy sediment in the watershed makes stormwater detention a very attractive management technique. Other erosive characteristics of sand make management difficult but still manageable with other watershed control techniques. The second priority after watershed sediment control is to minimize stream channel flow restrictions. At-grade stream crossings and blocked culverts have reduced the capacity of the stream to flow and deliver sediment from the watershed, which is the other half of the balance equation. These two steps will allow Cogdel's Creek to reach equilibrium more closely resembling natural conditions.

An ongoing channel inspection program should be implemented with this alternative to ensure that significant degradation of the stream channel due to increased flows does not occur. Channel bank toe protection may be required in later years if upstream attenuation of flows from impervious areas is not sufficient to prevent streambank erosion.

Projects included in this alternative first address the major sources of erosion in the watershed, and later restore the creek channel at crossings where sedimentation has limited the conveyance capacity. The projects include removal of a total of approximately 3,100 cubic yards of sediment. Figure 12 shows project locations, and Table 9 summarizes the preliminary project features and costs, as developed for the alternatives evaluation. Final project descriptions, as well as detailed costs and regulatory considerations are described in more detail in the following section (Remediation Plan).

Regulatory Considerations

Erosion control projects (Sites 1 through 9) should be designed to comply with CAMA requirements, and will need to be coordinated with the Land Quality Section of DWQ. Creek restoration projects and erosion control projects will need to be coordinated with the US Army Corps of Engineers and the North Carolina Division of Water Quality. Although the remediation projects appear to qualify for Nationwide Permit 13 (streambank stabilization) and Nationwide Permit 19 (minor dredging), the potential area of wetlands affected (about 6 acres) exceeds that allowed under the Nationwide Permit Program. As a result, an individual permit will probably be required for the entire remediation plan. However, mitigation could be negotiated to include only the wetland areas affected, although the Corps of Engineers and other reviewing agencies may request additional stream restoration as mitigation. For planning purposes, 6 to 8 months should be allowed to complete the wetland delineation, permit application, and agency permit review issuance.

Table 9. Alternative 2 Project Descriptions And Costs
Cogdel's Creek Watershed

Site No.	Location	Description	Cost [1]
1	G816 Area	Pave 30%, add storm drains w/sand traps, revegetate	$665,000
2	Tank Trail Area	Add improved tank trail, revegetate sand areas, limit access	$1,625,000
3	FC-100 Area	Pave 50%, add pond, regrade, extend storm sewer, add grassed swales	$781,000
4	FC-200 Area	Pave 90%, enlarge pond, improve outlet, add storm sewers	$1,691,000
5	Landfill Area	Review completion plan to ensure erosion minimized	None
6	Building 1775 Area	Vegetate buffer, add sand trap inlets, regrade	$86,000
7	Building 1450 Area	Repair/rebuild pipe inlets to pond, revegetate, regrade, enlarge pond to handle area north of Louis Road	$619,000
8	MT/ENG Building Area	Construct sediment pond east of building, armor ravine, revegetate bare areas	$894,000
9	Fenced Area Near Sneads Ferry Road	Install vegetated buffer, regrade unvegetated areas	$78,000
10a	Building 1854 Culvert Crossing	Clean out and repair culverts and immediately adjacent stream channel	$80,000
11a	Main Service Rd. Culvert Crossing	Clean out and repair culverts and immediately adjacent stream channel	$36,000
12a	Building P804 Culvert Crossing	Clean out and repair culverts and immediately adjacent stream channel	$53,000
13a	Sneads Ferry Road Culvert Crossing	Clean out and repair culverts and immediately adjacent stream channel	$43,000
14a	At-Grade Crossing 2	Eliminate crossing and ditch, restore channel cross-section	$27,000
15a	At-Grade Crossing 1	Eliminate crossing, restore channel cross-section	$57,000
16a	At-Grade Crossing 4	Eliminate crossing, restore channel cross-section	$25,000
17a	At-Grade Crossing 3	Eliminate crossing, restore channel cross-section	$48,000
18	ORRV Tributary Crossings	Eliminate crossings, restore channel cross-section	$42,000
		Total for Alternative 2 Projects	**$6,850,000**

[1] Order of magnitude costs are considered accurate to within minus 30 percent and plus 50 percent. These are preliminary costs; final costs are presented in the Remediation Plan section.

The North Carolina Division of Water Quality issues the water quality certificate required by the US Army Corps of Engineers before a wetland or dredging permit can be issued. The extent of jurisdictional wetlands and waters of the United States (unvegetated stream banks and stream bottoms) will need to be established to determine exactly which areas are subject to wetland and other Clean Water Act requirements. During design, creek restoration should be planned with regulatory agency staff to minimize disruption to the streambed and adjacent wetlands. The MCB Camp Lejeune Erosion and Sediment Control Plan should be updated to address the new facilities, and to include additional recommendations from this project.

Cost

The total order of magnitude cost for this alternative is estimated to be $6.9 million. Of this, it should be noted that about $450,000 is for the placement of topsoil to revegetate bare areas. The use of stabilized sludge for some of the larger sites will be evaluated in the ongoing solid waste management project; if feasible this could reduce costs. In addition, implementing portions of projects with MCB Camp Lejeune personnel could reduce costs. It is assumed that the projects in this alternative can be designed with agency input such that wetland mitigation is not required.

Erosion Control with Comprehensive Creek Channel Restoration (3)

Description

In order to restore the channel to closer to natural conditions more quickly, additional sediment can be removed mechanically. This involves removal of sediment in the channel and regrading the stream channel to be more reflective of pre-development conditions. This will quickly provide the free flowing stream channel of the recent past. It will also increase the hydraulic capacity and sediment delivery capability of the stream channel, reducing the time it will take to move back to a balanced watershed. This will likely reduce the maintenance required for keeping culverts clear of sediment as the stream stabilizes, as compared to Alternative 2.

This alternative includes the same projects as the second alternative (Figure 12 and Table 9), with the addition of projects 10b through 17b, which are summarized in Table 10. These projects involve the removal of an additional 9,500 cubic yards of sediment from Cogdel's Creek as compared to Alternative 2. It is important to note that the projects listed in Alternative 2 must be completed before those listed in Table 10 can be implemented. Otherwise, continued erosion along with the blocked culverts and crossings would allow sedimentation to continue and ultimately negate the effects of the channel restoration projects.

As in Alternative 2, an ongoing channel inspection program should be implemented with this alternative to ensure that significant degradation of the stream channel due to increased flows does not occur. Channel bank toe protection may be required in later years if upstream attenuation of flows from impervious areas is not sufficient to prevent streambank erosion. In order to minimize cost, sediment removal is only proposed in the stream channel, and not in the upland areas. In order to remove sediment that may have accumulated in the floodplain, extensive clearing and grubbing would be required. This type of sediment removal would have an overall negative impact on Cogdel's Creek.

Table 10. Alternative 3 Project Descriptions And Costs
Cogdel's Creek Watershed

Site No.	Location	Description	Cost [1]
10b	Upstream Building 1854 Culvert Crossing	Restore channel for 1,300 feet upstream	$1,229,000
11b	Upstream Main Service Road Culvert Crossing	Restore channel for 850 feet upstream	$601,000
12b	Upstream P804 Culvert Crossing	Restore channel for 1,600 feet upstream	$1,314,000
13b	Upstream Sneads Ferry Road Culvert Crossing	Restore channel for 500 feet upstream	$327,000
14b	Upstream At-Grade Crossing 2	Restore channel for 700 feet upstream	$874,000
15b	Upstream and Downstream At-Grade Crossing 1	Restore channel for 400 feet upstream and 400 feet downstream	$723,000
16b	Upstream At-Grade Crossing 4	Restore channel for 350 feet upstream	$189,000
17b	Upstream At-Grade Crossing 3	Restore channel for 550 feet upstream	$463,000
		Subtotal Alternative 3	$5,720,000
		Subtotal from Alternative 2 projects	$6,850,000
		Total Cost for Alternative 3	**$12,570,000**

[1] Additional projects common to both Alternatives 2 and 3 are listed in Table 9. Order of magnitude costs are considered accurate to within minus 30 percent and plus 50 percent. These are preliminary costs; final costs are presented in the Remediation Plan section.

Regulatory Considerations

Erosion control projects (Site Nos. 1 through 9) should be designed to comply with CAMA, US Army Corps of Engineers, and the Division of Water Quality requirements. Creek restoration projects will need to be coordinated with the US Army Corps of Engineers and the Division of Water Quality. The extent of jurisdictional wetlands and waters of the United States should be established to determine exactly which areas are subject to permitting requirements. Because of the large areas of wetlands and waters of the United States that would be adversely affected by this alternative, an Individual Permit would be required. Individual permit applications typically take 1 to 6 months to prepare and the agency review process can take up to a year, or more if the project is considered controversial.

It is anticipated that this alternative will require extensive work in areas that will now be considered wetlands. Potential mitigation, including creation of extensive areas of wetlands on other areas of the base, will likely be required. Typical costs associated with mitigation average $18,000 to $20,000 per acre for design, construction, and 5 years of monitoring. Because the proposed remediation plan will affect about 40 acres of wetlands, and it is likely the Corps of Engineers will require a 3 to 1 mitigation ratio, resulting in

significant mitigation costs. In addition, because of the large area of wetlands that would be adversely affected by the project, it is likely that other permit review agencies, such as the US Fish and Wildlife Service, and the Environmental Protection Agency, would object to one or more of the proposed projects. This could result in a protracted negotiation with the agencies to achieve buy-in on the objectives and needs for the project

The MCB Camp Lejeune Erosion and Sediment Control Plan should be updated to address the new facilities, and to include additional recommendations from this project.

Cost

The total cost for this alternative is expected to be approximately $12.6 million. Similar to Alternative 2, some revegetation cost for topsoil placement could be reduced if the use of sludge proves feasible (approximately $450,000), and use of base personnel could also reduce costs. The costs for projects 10a through 17a will be very dependent on regulatory agency policies regarding the extent of jurisdictional wetlands and the mitigation ratio required.

For this analysis, a rough estimate was made of wetland area based on the aerial photographs, and a mitigation factor of 3 to 1 was assumed (e.g. 3 acres of wetland must be created for every 1 acre impacted). The resulting mitigation cost totals $2.4 million, or 42 percent of cost for projects 10a through 17a. There is some possibility that wetland creation could be coordinated with the landfill closing to avoid the need for purchasing land; existing forested lands cannot be cleared for wetland mitigation. For this study, it was assumed that land purchase would be required at $4,000 per acre. If land purchase is not required, the savings would be about $480,000.

Summary and Recommendations

For either Alternative 2 or 3, erosion control projects should be completed first (Sites 1 through 9). Stream crossings should then be addressed (Sites 10a through 17a, and 18). If Alternative 3 is implemented, Sites 10b through 17b should be addressed last. In general, projects should be sequenced from upstream to downstream. Otherwise, there is the risk that disturbance from remediation activities could cause sedimentation at a project site just completed downstream.

It may be tempting to address stream crossing sites first (Sites 10a through 17a and 18), since the costs are only about 6 percent of the total Alternative 2 costs. However, without completing erosion control projects first, sedimentation will continue to occur in Cogdel's Creek. This would result in reforming of blockages in the culverts, and ultimately increase the frequency of required culvert cleaning.

Table 11 summarizes the three alternatives. The second alternative is recommended, since the no action alternative may ultimately result in higher costs and regulatory intervention, and the comprehensive restoration in the third alternative is not likely to be acceptable to regulatory agencies.

Table 11. Remediation Alternatives Summary
Cogdel's Creek Watershed

Alternative	Description	Cost	Comments
1	No action	Unknown	No immediate capital costs
			Higher maintenance costs; potential regulatory violations
2	Erosion control & strategic restoration	$5.8 million	Targets high priority projects; cost-effective
			Relies on natural processes for restoring channel to more natural conditions
3	Erosion control & comprehensive restoration	$12.6 million	Quickly restores stream channel to more natural profile
			Significant regulatory requirements; highest cost

Based on input from regulatory agencies, the selected alternative was refined and a remediation plan developed (presented in the next section). Projects can be phased from upstream to downstream, prioritizing areas that will have the most impact. It is likely that costs can be decreased for the erosion control projects after site objectives are clearly defined, and by optimizing each site layout based on more detailed data collection and analysis during final design.

Remediation Plan

The purpose of this section is to describe the proposed erosion/sedimentation remediation plan for the Cogdel's Creek watershed at Marine Corps Base (MCB) Camp Lejeune, North Carolina. The watershed assessment, completed in May 1998, specifically focused on identifying erosion and sedimentation problems, and evaluating alternatives for addressing the problems. A remediation strategy was identified at meetings held with MCB staff and regulatory agencies on June 8 and 9, 1998.

In general, regulatory agencies were supportive of the remediation strategy presented at the June meetings. The strategy is to proceed with Alternative 2, monitor the watershed for improvement, and then implement comprehensive creek channel restoration (Alternative 3) if necessary. This strategy recognizes that the first and most essential management technique for restoring Cogdel's Creek is to reduce the sediment delivered to the stream channel. The second priority after watershed sediment control is to minimize stream channel flow restrictions.

These two steps will allow Cogdel's Creek to reach equilibrium more closely resembling natural conditions. An assessment of the degree of sedimentation remaining after completing these steps will indicate whether additional sediment removal would be necessary or beneficial.

Project Descriptions

The following subsections describe existing conditions, conceptual plans, and maintenance requirements for site-specific remediation projects in the Cogdel's Creek watershed. Conceptual plans were developed based on field observations, recent aerial photographs and topographic mapping, discussions with MCB Camp Lejeune staff, and experience with similar projects. Short-term measures that can be taken to reduce erosion and sedimentation have been included if applicable.

Several of the projects, and the overall remediation strategy, are based on the assumption that the existing tank trails near the creek, and the at-grade tank crossings, can be eliminated. Support of this concept by the Command is essential to successful implementation of the remediation plan presented here. Alternatives to eliminating the trails and crossings (such as additional culvert crossings, hard tank crossings, and sediment traps along the trails) would be more expensive and be harder to implement from a regulatory standpoint.

Project site locations are shown in Figure 12. Table 12 lists some typical conceptual designs which may be applicable to each site; the conceptual designs are included in Attachment C. Project costs are included in Attachment D.

TYPICAL CONCEPTUAL DESIGNS		Applicable to Site									Stream Crossings								
		G816	Tank Trail	FC-100	FC-200	Landfill	Bldg 1775	Bldg 1450	MT/ENG	463L	Bldg 1854	Main Service Rd	P804	Sneads Ferry Rd.	At-grade 2	At-grade 1	At-grade 4	At-grade 3	ORRV
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A-1	Wet Pond			X	X			X	X										
A-2	Riser Type Sediment Basin							X	X										
A-3	Stone Inlet Sediment Trap	X		X	X		X	X	X										
A-4	Temporary Silt Ditch	X	X	X	X					X									
A-5	Gravel and Rip Rap Sediment Basin				X	X													
A-6	Restoration of Culvert Cross-Section		X		X		X				X	X	X	X					
A-7a	Removal of Stream Cross-Section		X		X										X	X	X	X	X
A-7b	Restoration of Stream Cross-Section		X		X						X	X	X	X	X	X	X	X	X
A-8	Culvert Outlet Erosion Protection	X		X	X		X	X	X										
A-9	Energy Dissipation Structures							X											
A-10	Temporary Sediment Trap		X	X	X														
A-11	Temporary Rock Check Dam	X	X	X	X														
A-12	Pervious Pavement	X		X	X		X	X	X	X									
A-13	Tank Trail Cross Section		X																

Table 12
Conceptual Designs for Project Sites

Surface Coverage Considerations

In order to minimize erosion, bare soil areas should be eliminated wherever possible. Traffic patterns will need to be analyzed at each site to develop a design that minimizes impervious surface while meeting the mission requirements of the site. Pervious surface alternatives for erosion control are preferable to pavement where traffic patterns will permit their use. In general, the following types of surfaces should be considered, in order of preference for minimizing erosion control impacts:

- *Vegetate* existing unpaved areas that are not often used. Terrace the areas to slow surface flow and promote infiltration.
- Install a *pervious pavement or geocell system* where traffic is too high for vegetation only. Use vegetation or crushed stone for the surface depending on traffic level.
- *Pave* very high traffic corridors. The paved areas should be designed for sheet flow runoff onto adjacent grassed strips.
- *Bare areas* can remain if necessary for the site mission. Such sites will need to be graded, with vegetative buffers, to contain erosion onsite, and maintenance should include periodic regrading and sediment removal from the buffers.

Vegetation

Most of the site plans call for revegetation of some bare areas. In the areas designated for revegetation or requiring vegetative stabilization, native species should be used to the extent practicable to minimize maintenance and improve survivability. The species, densities, and sizes of plant material shown in Table 13 were selected based on:

- vegetative surveys conducted as part of the watershed project;
- commercial availability;
- ease of planting; and
- generally high survivability.

For large expanses such as the tank training area at Site 2, the site will need to be treated two to four times with sludge or have significant quantities of topsoil and commercial fertilizers applied because the soil has very low fertility and would not readily revegetate. Slow-release fertilizer should be placed in the planting holes of all trees and shrubs. No additional fertilizers or lime should be required. Plants should be installed in the fall or winter (October through February) to increase survivability and limit the need for watering and other maintenance activities. No mowing or other maintenance should be required except for 1) turfgrasses in currently maintained areas and 2) removal of woody growth on berms and in swales.

Table 13. Vegetation Plan For Camp Lejeune
Cogdel's Creek Watershed

Plant Group	Species	Density/size
Trees	Swamp Chestnut Oak (*Quercus michauxii)* Sweetgum (*Liquidambar stryraciflua*) Black Gum (*Nyssa sylvatica*) Willow oak (*Quercus phellos*) Sycamore (*Plantanus occidentalis*)	Plant on ten-foot centers 1inch caliper, 3 to 5 ft tall
Shrubs	Silky Dogwood (Cornus ammomum) Swamp Dogwood (Cornus foemina) Speckled alder (Alnus serrulata) Hibiscus (Hibiscus moscheutos) Swamp rose (Rosa palustris) Buttonbush (Cephalanthus occidentalis)	Plant on 5-foot centers 1 gallon pot size
Herbaceous	Broom sedge (Andropogon virginicus) Switch grass (Panicum virgatum) Mixed turfgrasses (limited to areas routinely mowed and maintained)	Grasses should be seeded; erosion control material should be used in accordance with NC Sediment Control Commission practice standards

Site No. 1: GP816 Area

Existing Conditions

The site encompasses a total of 21.5 acres, shown in Figure 13. Approximately 5 percent of the area is impervious, 40 percent of the area is covered by grass or trees, and 55 percent of the area is bare soil. The site is used for temporary bridge deck storage and temporary bridge deck installation training. The impervious area is mostly building roofs. The bare soil area is used for training and storage.

Storm water runs overland towards the south and southwest where it enters a ditch, flows under Gonzalez Boulevard, and enters Cogdel's Creek. The site is as close as 10 feet to the ditch, which is tributary to Cogdel's Creek.

Approximately 4 acres of mostly bare land drain directly to the ditch. A significant amount of eroded sediment was observed at the extreme west end of the site. The condition of the ditch is good with some evidence of sediment accumulation and side slope erosion. Side slope erosion is particularly evident in the vicinity of the headwalls used for temporary bridge construction training.

The remainder of the site drainage flows through a forested area before entering the ditch. Field observations indicate that the forested area filters out sediment before it reaches Cogdel's Creek.

Remediation Plan

- Vegetate a buffer (50 feet wide) along the edge of the ditch (1000 feet long).
- Vegetate the buffer along the Main Service Road (350 feet).
- Construct a low berm along the ditch to promote infiltration and limit overland flow down the ditch bank.
- Install inlets with sand traps and drop manholes in the vegetated buffer (5 structures).
- Analyze traffic patterns and develop a site design, which minimizes impervious surface while meeting the mission requirements of the site. For budgeting purposes, it is assumed that 30 percent of the site remains unpaved and unvegetated, 40 percent is vegetated, and 30 percent is paved.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after major storms during construction and at the completion of construction activities. Repair facilities as necessary.
- Vacuum sand traps following construction and after vegetation is established. Vacuum twice a year or as necessary thereafter.
- Regrade unvegetated parking area annually to re-establish eroded soil in sloped areas.
- Vacuum sweep paved surfaces quarterly or as necessary to remove sediment that is tracked or washed onto paved surfaces.

- Remove sediment annually or as necessary in the vegetated buffers next to the ditch.
- Mow vegetation in the ditch seasonally or as necessary to remove woody growth.

Short-Term Measures

Install temporary silt ditches or a sediment basin (through grading) at the southwest edge of the site to manage erosion from bare areas.

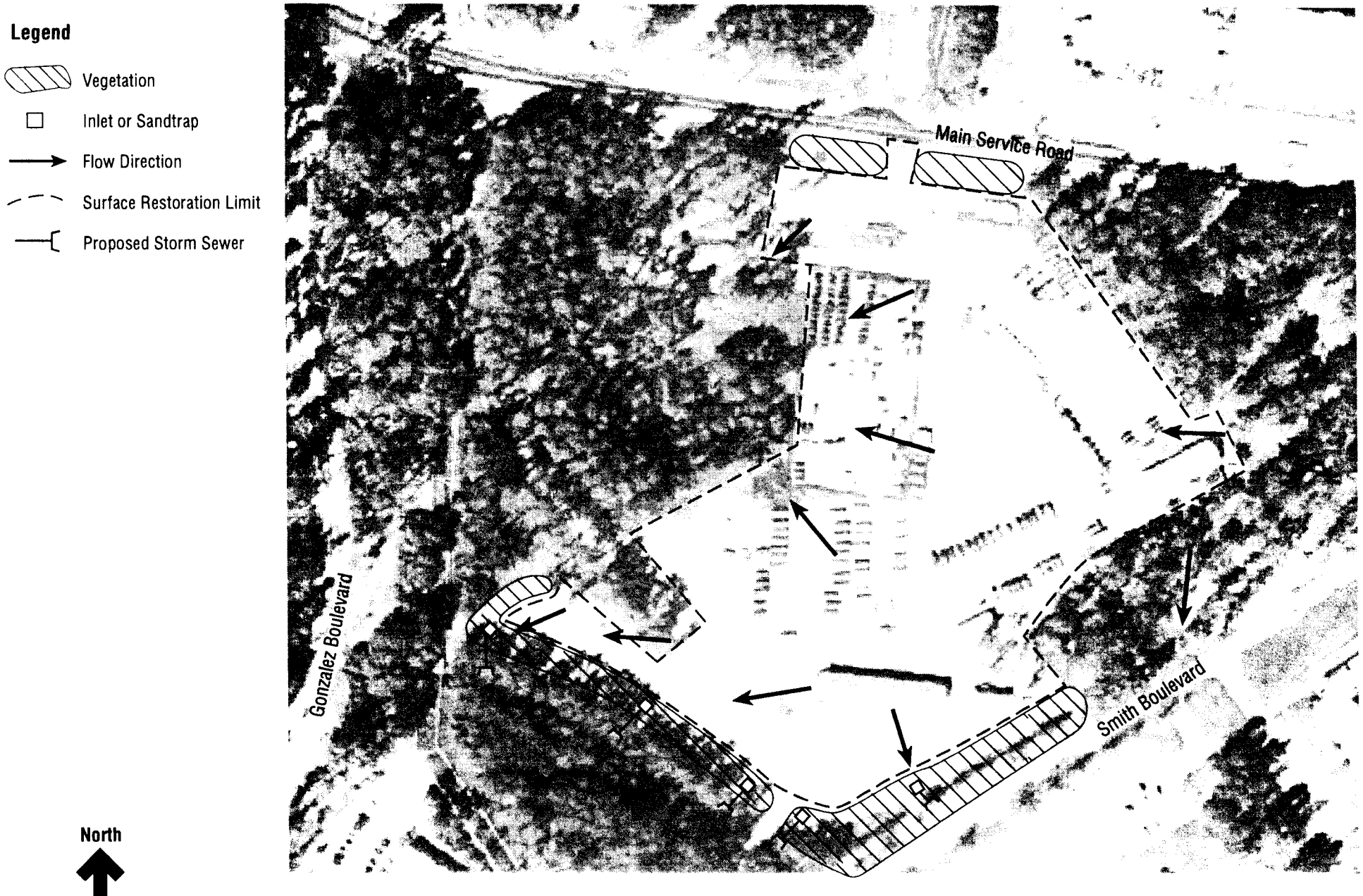


Figure 13

Site 1: GP816 Area

Cogdel's Creek

CH2MHILL

Site No. 2: Tank Trail Area

Existing Site Conditions

There are approximately 2.6 miles of bare soil tank trails currently used for tank testing after maintenance between the Tank Maintenance Building 1854 and Building P804. The trails provide conduits for eroded sediment to reach Cogdel's Creek by way of the at-grade tank crossings (Site Nos. 14-17). The trails are generally between 10 feet and 800 feet from Cogdel's Creek. The approximate locations of the trails are shown in Figure 12. The site-specific best management practices (BMPs) recommendations are given on Figure 14.

In addition, there is a large bare site encompassing 17 acres that is as close as 100 feet to Cogdel's Creek. Over 10 acres of this site is mildly sloping bare soil areas with few trees. The area is located on a road used by tanks from the Tank Maintenance Building to access the existing tank trail system near Cogdel's Creek. This area does not have an official designated purpose, but it is often used as a maneuvering area for tanks, off-road vehicles, and all terrain vehicles (ATVs). A portion of the area is currently designated as an off-road recreational vehicle (ORRV) area for motorcross, although this use is being re-evaluated by the Base. Vehicle traffic has eliminated vegetation in this area. As the water flows overland, the bare soil easily erodes down slope toward Cogdel's Creek.

Remediation Plan

- Construct 4,600 feet of new gravel tank trail as shown to access the improved tank trail northeast of Sneads Ferry Road. The road section should be crowned, sloping to grassed swales, to avoid ponding on the road. Frequently spaced small diameter (minimum 15-inch) culverts should be used instead of a few large culverts to avoid concentrating drainage. For budgeting purposes, a total of ten 15-inch culverts was assumed.
- In the open area, construct grassed berms along down slope areas to spread concentrated flows and promote temporary ponding and infiltration along the perimeter of the area.
- Install posts or fences to protect vegetated areas from traffic and to restrict vehicle access to Cogdel's Creek.
- Revegetate all disturbed areas and closed unimproved roads with grass.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after major storms during construction and at the completion of construction activities. Repair facilities as necessary.
- Maintain new tank trail and any remaining unimproved roads. Maintenance should include regrading as necessary to prevent ponding on roads, which tends to accelerate erosion with vehicle traffic.

Short-Term Measures

- Discontinue use of the at-grade crossings and tank trails leading to the edge of Cogdel's Creek.

- Grade to install grassed berms at the edges of bare areas to form temporary sediment basins. This should be focused on areas adjacent to the creek, especially at the ends of trails that are serving as conduits for eroded soil.

North

0 500

SCALE IN FEET

Legend

Vegetation

Vehicle barricade

Figure 14

Site 2: Tank Trail Area

Cogdel's Creek

CH2MHILL

Site No. 3: FC-100 Area

Existing Site Conditions

Three adjacent building sites (FC-100, FC-134, and FC-120), along the Main Service Road, encompass nearly 24 acres. The sites are shown on Figure 15. Approximately 45 percent of the area is impervious, 18 percent of the area is vegetated, and 37 percent of the area is bare soil. Water generally flows towards the north end of each building site where it enters a wooded area adjacent to Cogdel's Creek. The sites are within 100 feet of the wooded area and as close as 700 feet to Cogdel's Creek. These sites have been combined because while each building site may have different water quality management needs, the sites can combine BMPs to improve sediment control and water quality.

At Building FC-100, the impervious area is drained by storm sewers to the north onto unvegetated soil. The stormwater flows overland 400 feet across this bare soil and into the wooded area adjacent to Cogdel's Creek. Significant sediment has been carried along this path to the north end of the site toward Cogdel's Creek. This is evident by exposed fence post footings at low points along the north fence line.

At Building FC-134, the impervious area is drained by storm sewer to a small detention pond located at the site's northwest corner. The detention pond appears to be functioning well. Some erosion was observed on the side slopes leading down to the pond water surface. The pond discharges to the east into a drainage ditch.

The Building FC-120 site is almost all impervious. Storm sewers that drain from the site discharge to a vegetated ditch along the east edge of the site at Building FC-134. The water discharging from the storm sewer has blackened the sand and stones in the ditch bottom that flows towards Cogdel's Creek.

Remediation Plan

- Replace the gate at the northeast corner with fencing to eliminate vehicle traffic to the tank trail (this can also be implemented as a short-term measure).
- Install a 50-foot wide grassed swale along the east and south perimeter of FC-100. This will provide sediment trapping for runoff leaving the storm-sewered area of Building FC-100 and control delivery of sediment from the adjacent areas.
- Provide riprap reinforcement at the outlet of the existing storm sewer from FC-120 to reduce ditch erosion.
- Extend the storm sewer located along the west side of FC-100 to the north edge of the sand parking area and along the north edge of the parking area. Install sand traps at sewer inlets.
- Construct a sediment pond at the north border of the site between FC-120 and FC-100. The sediment pond will receive flow from the storm sewer systems of both building sites. The pond will have stilling basins at the east and west ends and discharge through a baffled standpipe. Two larger culverts will be installed under the tank trail to accommodate major storms from all three of the building sites.
- Install a staging area for pond maintenance equipment.

- Analyze traffic patterns and develop a site design which minimizes impervious surface while meeting the mission requirements of the site. It is assumed for budgeting purposes that 50 percent of the current 5.5-acre unvegetated area be paved, 25 percent of the area be grassed, and the remaining 25 percent of the area be graded and remain unvegetated.
- Vegetate bare areas adjacent to the tank trail.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after major storms during construction and at the completion of construction activities. Repair facilities as necessary.
- Vacuum sand traps following construction and after vegetation is established. Vacuum twice a year or as necessary thereafter.
- Regrade the unvegetated parking area annually to re-establish the surface and reduce concentrated flow paths.
- Remove sediment from pond stilling basins using a backhoe every 5 years or as necessary.
- Vacuum sweep paved surfaces quarterly or as necessary to remove sediment that is tracked or washed onto paved surfaces.
- Remove sediment in vegetated buffers annually or as necessary.
- Mow vegetation in buffers seasonally to remove woody growth.

Short-Term Measures

- Install a temporary sediment basin with a riprap outlet at the northwest corner of the site to prevent erosion from bare areas leaving the site.
- Grade to install temporary silt ditches running east/west in the unvegetated area of the northern half of the site. These should slow down runoff to minimize erosion reaching the far north end.

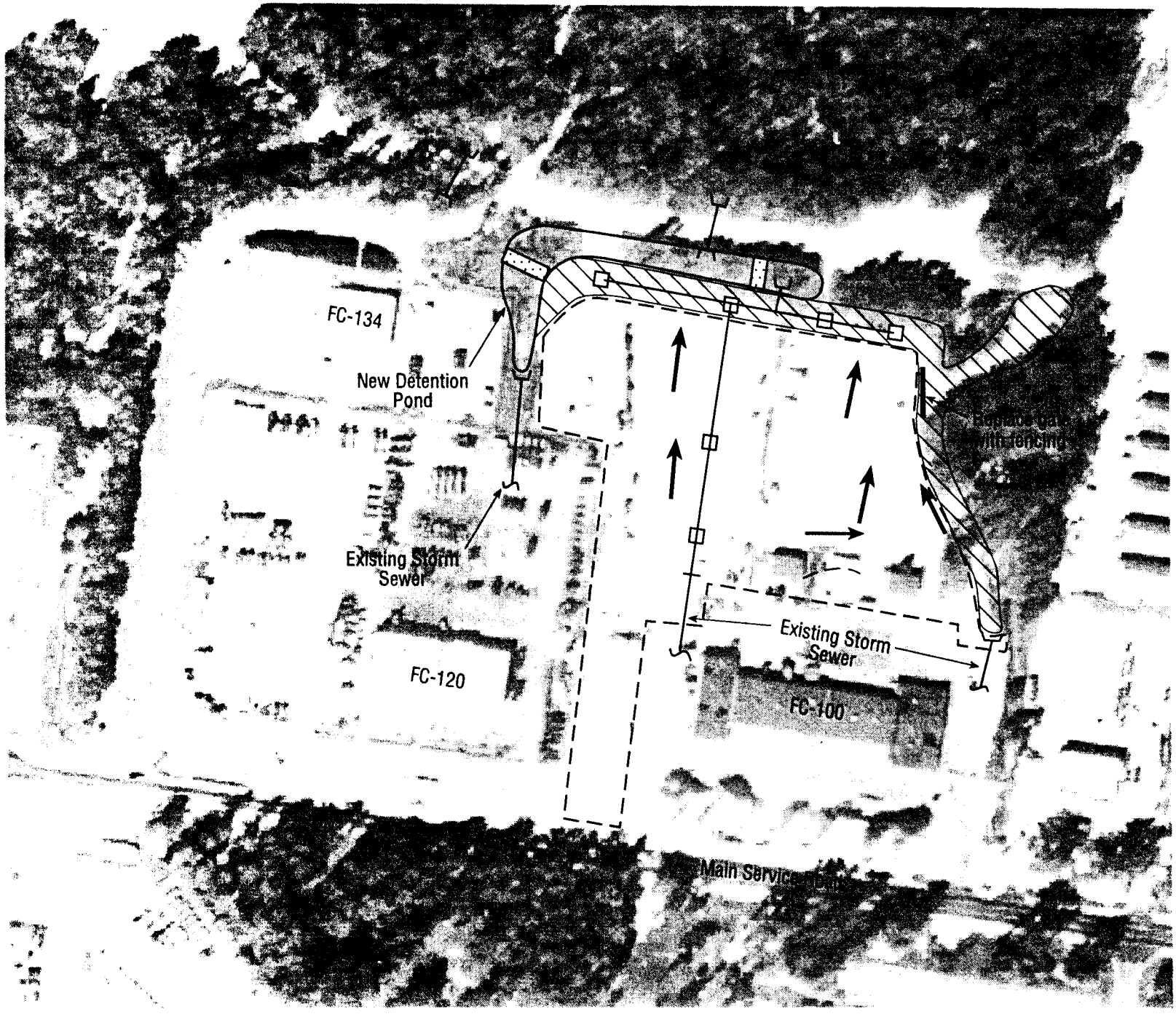


Figure 15
Site 3: FC-100 Area
Cogdel's Creek

Site No. 4: FC-200 Area

Existing Site Conditions

The FC-200 site, on the Main Service Road, includes about 20 acres of a 23-acre sub-basin draining to Cogdel's Creek. The site is shown on Figure 16. There are numerous buildings on the site. The site is approximately 75 percent pervious surface consisting of native sandy soil that is generally unvegetated. There is frequent auto and heavy equipment traffic on portions of this pervious surface. The remaining 25 percent of the site is impervious surface consisting of building rooftops and some parking areas. Storm water from rooftops drains to the pervious ground surface. There are no significant storm sewers on the site. Sheet and rill erosion of soil from the unvegetated areas is periodically graded and repaired to maintain a driving surface for automobiles and heavy equipment.

The FC-200 site slopes gently to the north toward Cogdel's Creek. Storm water runoff from a small portion of the site drains to a sedimentation basin at the north edge of the site. The sedimentation basin is adjacent to the wooded area adjoining Cogdel's Creek and within 400 feet of the creek itself. The majority of the area draining into the pond comes from the adjacent P-804 site. A 54-inch sewer drains 19 acres, almost all impervious, from the P-804 area to the pond. The basin appears to be well maintained. The side slopes are sparsely vegetated and appear to be periodically mowed. The basin outlet is a broad crested weir that discharges to the adjacent unimproved roadway. There is a low flow outlet from the basin that is completely blocked by sediment and vegetation. This keeps the normal pond elevation higher than the original design.

Downstream of the pond, water collects in an eroded segment of the roadway. This eroded segment was formed by heavy vehicle traffic that has displaced soil from the road. The displaced soil has formed berms along both shoulders of the road.

There is a significant volume of sediment downstream of the road that has filled the drainage path to Cogdel's Creek. The source of sediment appears to be uncontrolled storm water from the portion of the FC-200 site that drains around the west end and bypasses the sedimentation basin. Evidence of significant erosion can be observed in this area.

Remediation Plan

- Establish the alignment of the tank trail to the north of the site and vegetate bare soil areas adjacent to the tank trail.
- Analyze traffic patterns and develop a site design, which minimizes impervious surface while meeting the mission requirements of the site. For budgeting purposes, it is assumed that 90 percent of the existing bare area is paved, with the rest graded and vegetated to slow runoff and promote infiltration.
- Install storm sewers with grassed inlet areas and sand traps at storm sewer inlets to offset the impacts of increased impervious area. .
- Enlarge the sedimentation basin along the north edge of the site to accommodate runoff from the FC-200 area. Install baffles and forebays in the basin to form stilling basins at pond inlets to improve sedimentation. Provide staging areas for basin maintenance equipment.

- Provide a stand pipe outlet structure that will contain floating material within the basin. Extend the outlet pipe to the north side of the tank trail. Provide an overflow structure for major storms. Extend the overflow structure across the tank trail to prevent washout of the trail.

- Extend a drainage ditch from the outlet pipe to Cogdel's Creek. Provide erosion protection at the discharge point.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after storms during construction and at the completion of construction activities. Repair facilities as necessary.

- Vacuum sand traps following construction and after vegetation is established. Vacuum twice a year or as necessary thereafter.

- Remove sediment from pond stilling basins every 5 years or as necessary. Sediment levels in the pond and outlet structure should be inspected annually.

- Vacuum sweep paved surfaces quarterly or as necessary to remove sediment that is tracked or washed onto paved surfaces.

Short-Term Measures

- Grade to install temporary silt ditches running east/west in the unvegetated areas of the site. These should slow down runoff to minimize erosion reaching the north end.

- Build a temporary sediment basin at the northwest corner of the site (where detention pond expansion will go) using earthen berms. Route overflow from the temporary basin to the existing pond at the northern end of the site, using either a pipe with a sediment trap inlet or a riprap channel.

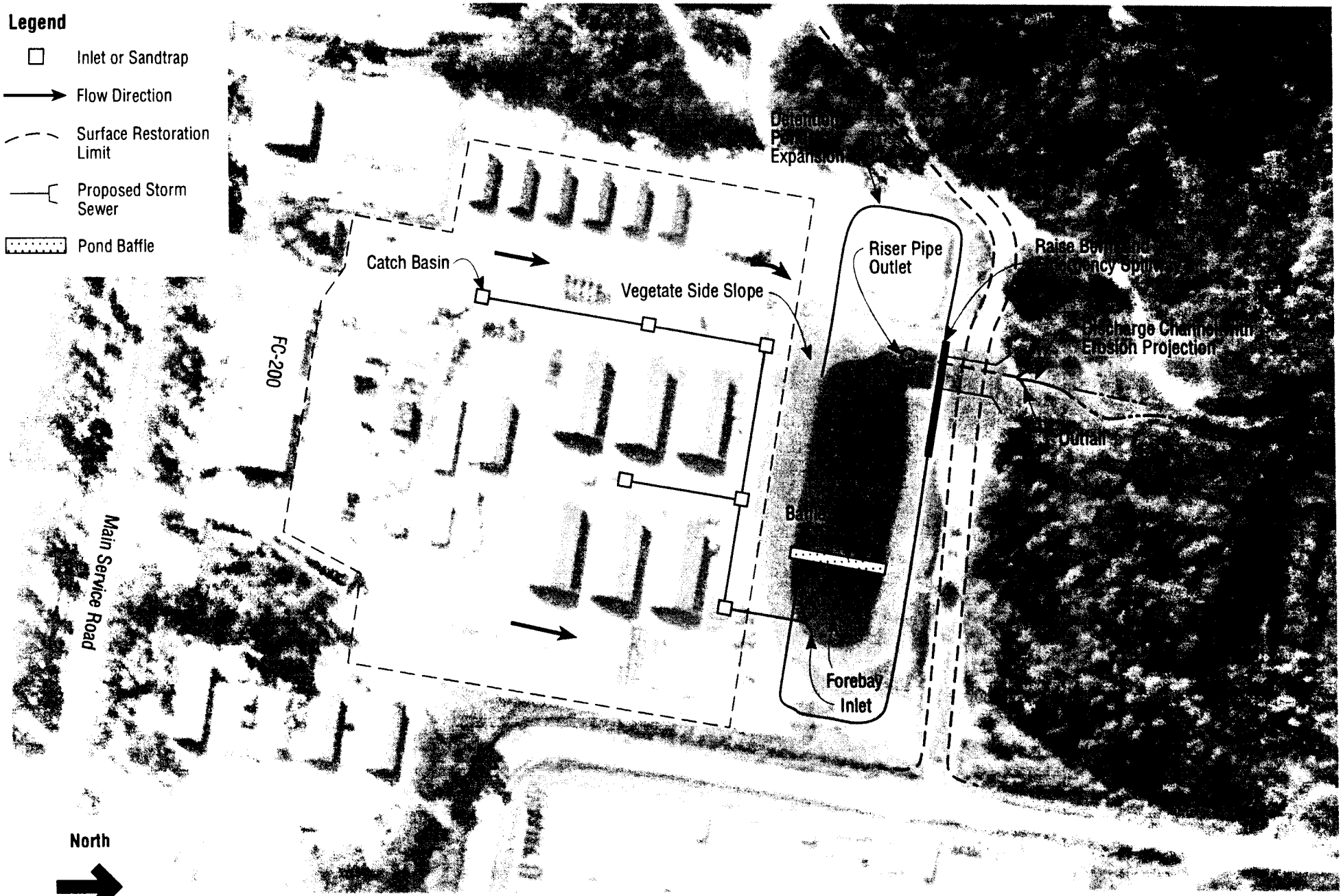


Figure 16
Site 4: FC-200 Area
Cogdel's Creek

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Site No. 5: Landfill Area

Existing Site Conditions

The landfill occupies approximately 140 acres on the east side of Sneads Ferry Road. The site is shown on Figure 17. About 95 percent of the site is either unvegetated or sparsely vegetated. The land slope on the landfill ranges from 17 percent on the high end to about 4 percent on the low end. The landfill is closed and a project is underway to place a combination synthetic and earth cover over the landfill. Runoff from the landfill drains to Cogdel's Creek as well as to French Creek, the adjacent watershed to the south. Runoff enters Cogdel's Creek either by first flowing through a small detention basin or by overland flow. The detention basin is within 400 feet of Cogdel's Creek.

Landfills can be a significant source of sediment loading to waterways unless extensive erosion and sediment control measures are implemented. Based on our field investigation it is likely that the landfill is contributing sediment to Cogdel's Creek. Erosion and sediment from the landfill is expected to continue throughout construction of the landfill cap unless aggressive construction erosion control measures are implemented. Depending upon the vegetation growth success on the landfill cap, erosion may continue to be significant even after the landfill cap construction is complete.

Plans for closure of the landfill include provisions for construction erosion control and ultimately for sediment control after the project is complete.

Remediation Plan

The current condition of the landfill, which has significant areas of sloped and unvegetated areas, has significant potential to deliver sediment to Cogdel's Creek. It is recommended that the current construction erosion control plan be reviewed and compared to conditions in the field to determine if immediate measures are necessary for sediment control.

The future potential for sediment delivery from the landfill is high. It is recommended that final construction plans be reviewed to determine if erosion and sediment control measures will be effective. Discussions with MCB Camp Lejeune staff (Fountain Taylor) indicate that the sediment basin, which is the main sediment control feature for the finished site, is limited in size due to site conditions. The size of the sediment basin should be reviewed to determine if it meets current State requirements for size and sediment control effectiveness.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after storms during construction and at the completion of construction activities. Repair facilities as necessary.
- Comply with inspection requirements of landfill site closure plan.

Short-Term Measures

- Inspect existing sediment pond and repair or modify if needed.

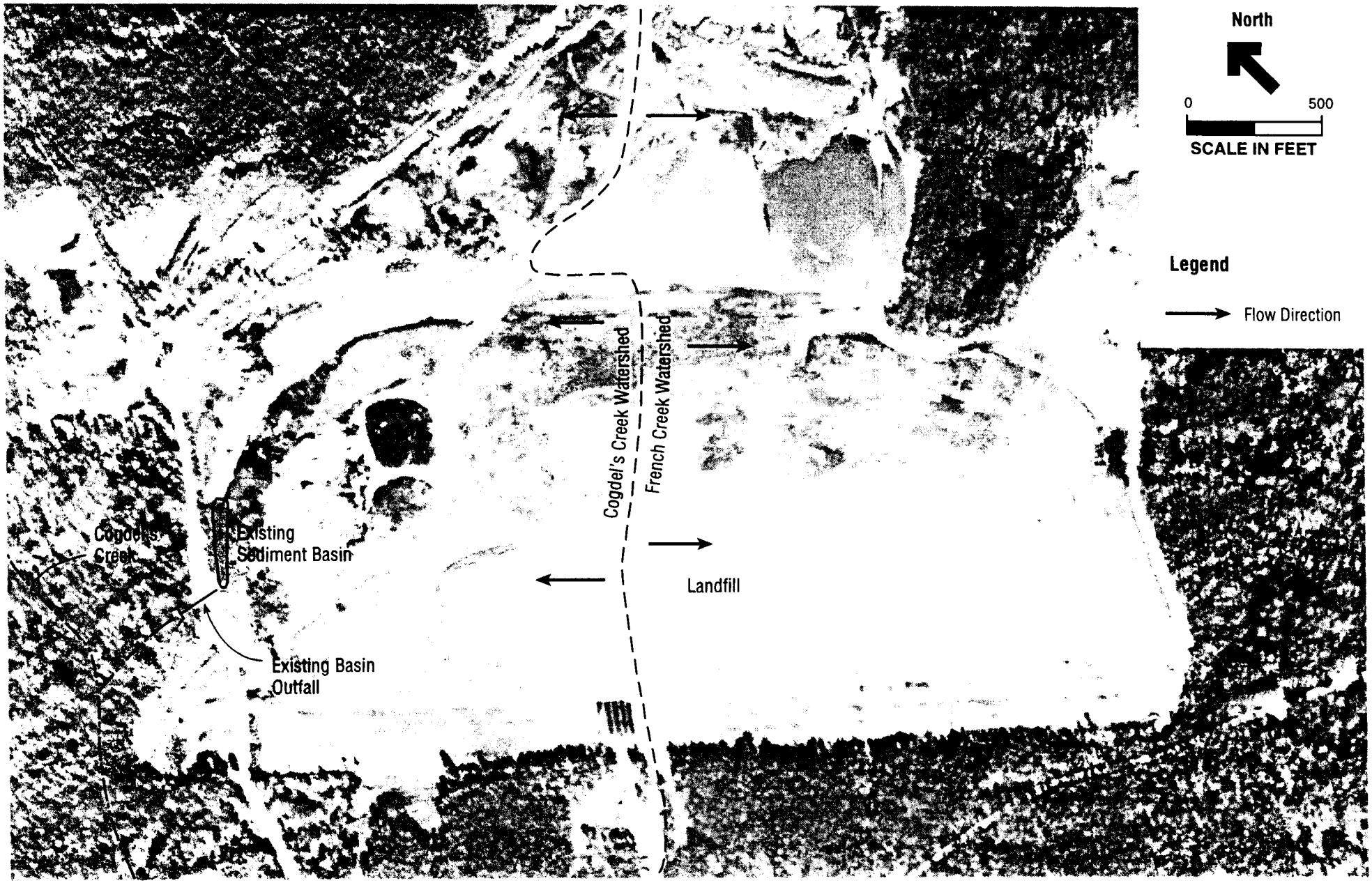

Figure 17

Site 5: Landfill Area

Cogdel's Creek

CH2MHILL

Site No. 6: Building 1775 Area

Existing Site Conditions

This vehicle staging area occupies about 6 acres, located between Duncan Street and Louis Road just northwest of the Tank Maintenance Building. The site is shown on Figure 18. The entire site is bare soil. The site slopes gently towards the south, and is drained by overland flow. A storm sewer, which intercepts the site runoff, runs along the southwest boundary of the site and transitions to a ditch approximately halfway along the southwest site boundary. This ditch is a direct tributary to Cogdel's Creek. There is little vegetation between the site and the ditch for filtering sediment.

Remediation Plan

- Vegetate a buffer (50 feet wide) along the edge of the ditch (300 feet).
- Vegetate the buffer along Duncan Street. (200 feet).
- Install erosion protection at the storm sewer outfall, and repair and revegetate the ditch (400 feet).
- Install inlets with sand traps and drop manholes in the vegetated buffer (3 structures).
- Analyze traffic patterns and develop a site design, which minimizes impervious surface while meeting the mission requirements of the site. For budgeting purposes, it is assumed that the area can be graded to control erosion.
- Grade site to provide lateral swales that will slow surface flow and promote infiltration.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after major storms during construction and at the completion of construction activities. Repair facilities as necessary.
- Vacuum sand traps following construction and after vegetation is established. Vacuum twice a year or as necessary thereafter.
- Regrade unvegetated area annually to reestablish eroded soil in sloped open areas.
- Remove sediment in vegetated buffer annually or as necessary.
- Mow vegetation in the vegetated buffer seasonally to remove woody growth.

Short-Term Measures

- Install a temporary grassed berm/sediment basin at the south corner.
- Install temporary silt ditches running east-west, to slow runoff toward the south corner.

Figure 18

Site 6: Building 1775 Area

Cogdel's Creek

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Site No. 7: Building 1450 Area

Existing Site Conditions

Approximately 19 acres drain to the pond near Building 1450, just southeast of Louis Road. The site is shown on Figure 19. The tributary area is estimated to be 90 percent impervious and the remaining 10 percent is either vegetated or bare soil.

Most of the area drains through storm sewers to the pond. The rest of the area drains by overland flow into the pond. The detention pond appears to need maintenance. The side slopes of the pond are very steep and are experiencing rill erosion caused by runoff from the adjacent parking lot. The northerly storm sewer inlet to the pond releases concentrated flow onto the steep side slope about 5 to 6 feet above the normal pond water surface. As a result, the pond side slope is severely eroded in that area. Sediment from the side slope erosion and other sources has accumulated in the pond. This sediment needs to be removed from the pond. The sediment pond discharges to a ditch along the southwest border of the site. The ditch continues for about 1,600 feet to Cogdel's Creek. The sediment pond is located within 150 feet of the ditch.

Just upstream of the pond outfall, a 48-inch storm sewer discharges into the ditch. The sewer drains a large 72-acre industrial area north of Louis Road. This sewer discharges to the ditch that flows along the southwest border of the site. The ditch is experiencing some erosion downstream of the 48-inch sewer. The land tributary to the 48-inch storm sewer is approximately 85 percent impervious and 15 percent vegetated. Preliminary measurements indicate the invert of the 48-inch sewer near Louis Road is 3 to 4 feet above the normal water surface elevation of the pond.

Remediation Plan

- Install a drop manhole and new inlet extension for the northerly inlet to the pond. Repair previous erosion damage and revegetate the area with heavy construction erosion protection.
- Remove existing sediment that has been deposited in the pond from erosion around the inlet pipes.
- Install a berm along the northeast fence line to prevent sheet flow from the paved parking area from causing erosion as it spills down the basin side slope. Revegetate and provide heavy erosion protection on the basin side slope.
- Install an interceptor storm sewer from the 48-inch storm sewer to divert runoff from the industrial area (to the north) to the sediment basin. The sewer should be sized to divert runoff from a 1-inch rainfall. This will prevent further erosion in the ditch near the outfall of the existing storm sewer, and provide wet detention treatment of the runoff from the industrial area.
- Enlarge the existing pond to accommodate the additional drainage area. Install pond baffles and forebays to create stilling basins for improved sediment trapping and to facilitate sediment removal. An embankment hazard classification may be necessary for the pond depending upon final design configuration.

- Install a new pond outlet structure and overflow structure to optimize the pond volume and sediment capture characteristics.
- Install a staging area for pond maintenance equipment.
- Revegetate the bare sand area in the south corner of the site within the fence line.
- Establish limits for the service drive along the southeast border of the site. Revegetate other areas and install barricades to restrict vehicle access to wooded areas.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after storms during construction and at the completion of construction activities. Repair facilities as necessary.
- Remove sediment from pond stilling basins using a backhoe every 5 years or as necessary.
- Vacuum sweep paved surfaces quarterly or as necessary to remove sediment that is tracked or washed onto paved surfaces.

Short-Term Measures

- Use sandbags, or increase the curb height, at the edge of the parking lot on the western end of the site. This will prevent runoff from overtopping the existing curb and eroding the eastern bank of the pond.
- Install rock check dams in the channelized area at the southern edge of the site, with a temporary berm at the end to minimize further erosion.

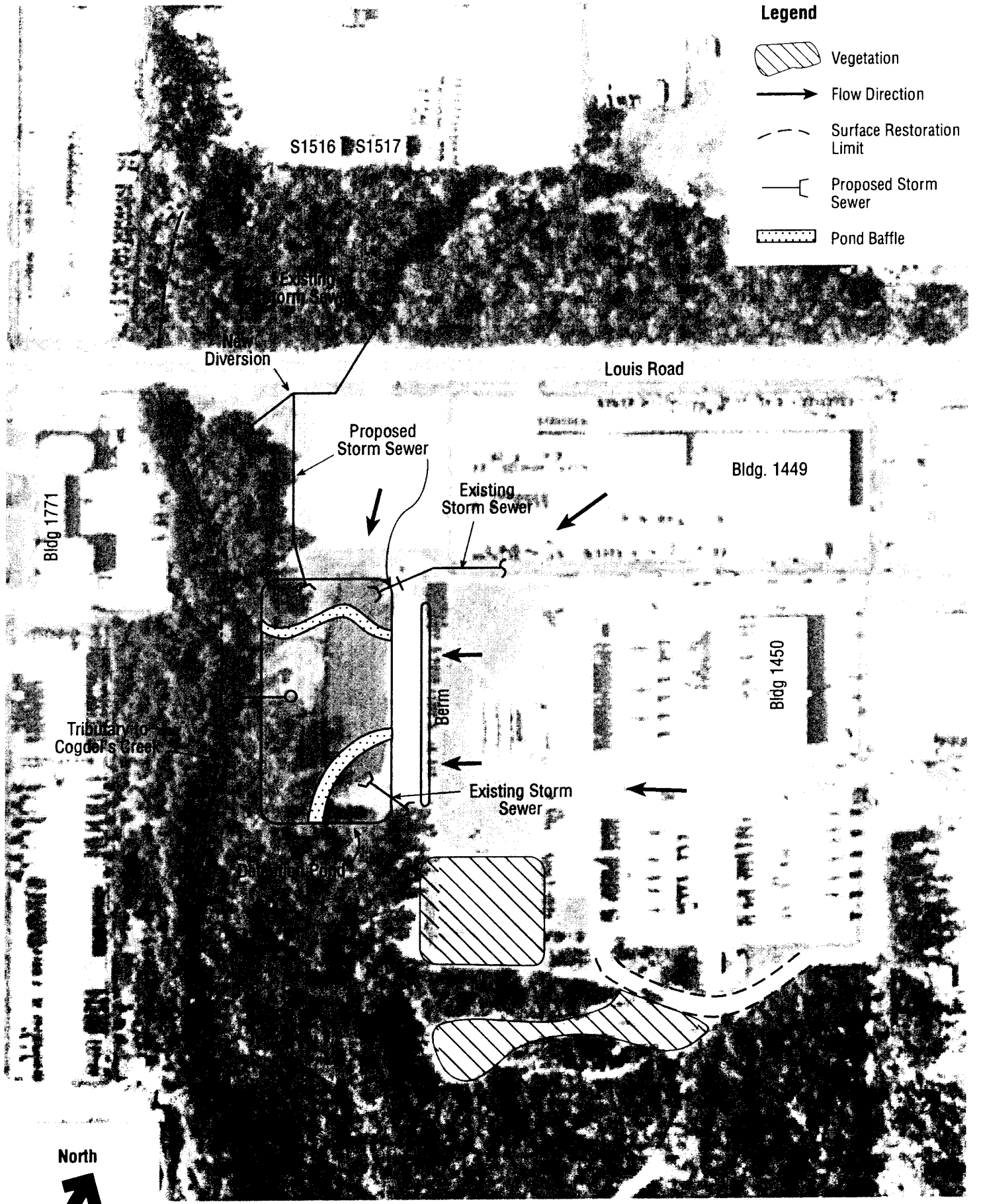

Figure 19

Site 7: Building 1450 Area

Cogdel's Creek

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Site No. 8: MT/ENG Building Area

Existing Site Conditions

A total of 21 acres, near the MT/ENG Building on "O" Street, drains to the Maintenance Building storm sewer outfall. The site is shown on Figure 20. The area is approximately 90 percent impervious with the remaining 10 percent vegetated. The impervious area is composed of building roofs, parking lots, and roads. The site is within 400 feet of a deep ravine tributary to Cogdel's Creek, which has very steep side slopes and showed evidence of erosion. The outfall discharges into the ravine.

A second outfall drains an additional 23 acres of land northwest of the Maintenance Building. This area is approximately 80 percent impervious with the remaining surface vegetated. This second outfall shares an outfall structure headwall with the Maintenance Building storm sewer outfall before it discharges into the ravine.

A third and fourth outfall convey runoff to the ravine from the east side of the site. The combined tributary area of these sites is approximately 70 acres, which consists of 75 percent impervious and 25 percent grassed areas. The impervious area is from buildings, roads, and parking areas.

Remediation Plan

- Construct a sediment pond in the wooded area east of the MT/ENG. Building. The sediment pond will receive flow from all four storm sewer systems. The pond will have stilling basins at the east and west ends and discharge through a baffled standpipe. The outlet discharge will flow through a drop manhole before discharging to the ravine. The pond overflow will be armored with stone to prevent erosion.
- The bottom of the ravine will be armored with stone (500 feet) to reduce the rate of erosion at the toe of the ravine and the resulting erosion up the ravine side slopes.
- Revegetate bare soil areas in the vicinity of the MT/ENG. Building.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after major storms during construction and at the completion of construction activities. Repair facilities as necessary.
- Remove sediment from pond stilling basins every 5 years or as necessary.
- Vacuum sweep paved surfaces quarterly or as necessary to remove sediment that is tracked or washed on to paved surfaces.

Short-Term Measures

- Revegetate bare areas.

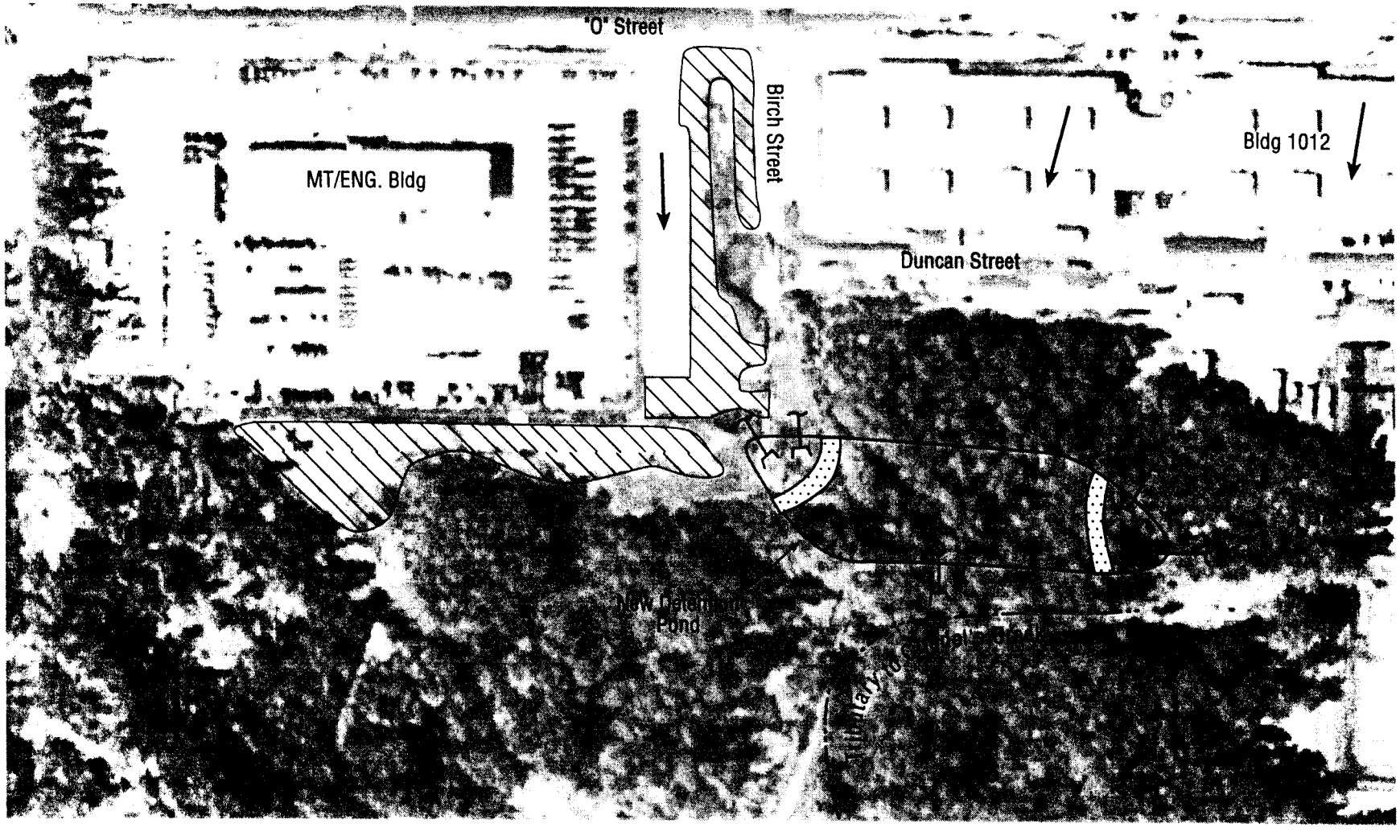


Figure 20
Site 8: MT/ENG Building Area
Cogdel's Creek

Site No. 9: 463L Pallet Loading Area

Existing Site Conditions

This site, located south of Sneads Ferry Road in the midst of unimproved roads along Cogdel's Creek, encompasses over 7 acres. The site, shown in Figure 21, is 85 percent bare soil and appears to be used for equipment and vehicle storage. Runoff from the site is generally to the south toward Cogdel's Creek. A portion of the site (about one third) drains toward a dirt trail and flows along the dirt trail directly to Cogdel's Creek. The remainder of the site drains to the southwest through a wooded area and eventually into Cogdel's Creek. The site is 750 to 1000 feet from Cogdel's Creek.

Remediation Plan

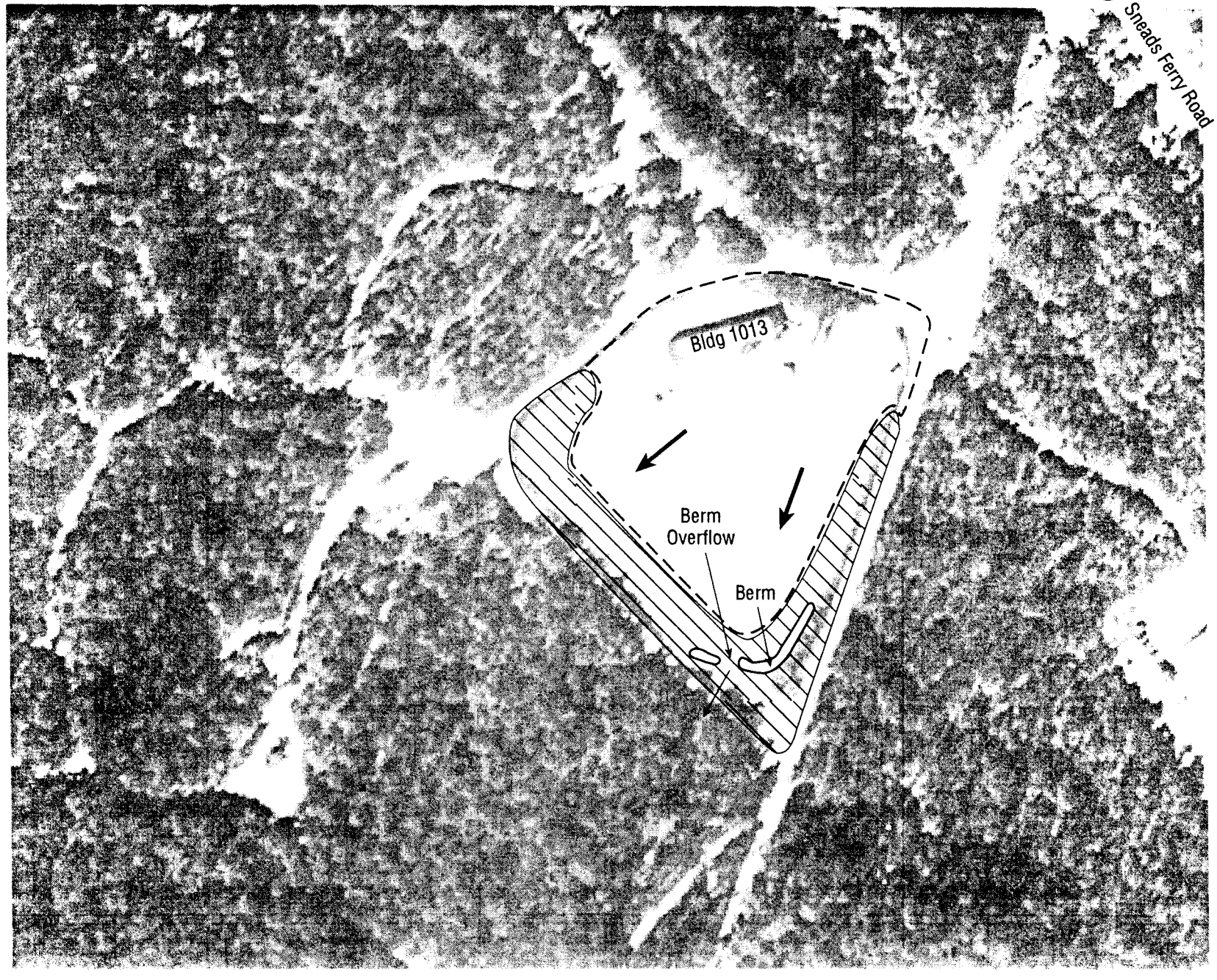
- Install a berm and vegetated buffer along the southwest and southeast border of the site (50 to 75 feet wide and 800 feet long).
- Install an overflow on the berm to limit water depths next to the berm to 6 inches. The overflow will also divert storm water runoff flow from the road to the forested area southwest of the site.

Maintenance Requirements

- Inspect all site storm water and sediment control facilities after storms during construction and at the completion of construction activities. Repair facilities as necessary.
- Regrade unvegetated area annually to re-establish eroded soil in sloped open areas.
- Remove sediment in grassed swale and buffer annually or as necessary.
- Mow grassed swale and buffer seasonally to remove woody vegetation.

Short-Term Measures

- Install temporary swales (east-west) to slow runoff toward the southern end of the site.



Legend

- Vegetation
- Flow Direction
- Surface Restoration Limit

North

0 200

SCALE IN FEET

Figure 21

Site 9: 463L Pallet Loading Area

Cogdel's Creek

CH2MHILL

Site Nos. 10a-17a and 18: Stream Crossings

As presented in the *Watershed Assessment for Cogdel's Creek*, there are two sets of projects for Sites 10 through 17, which were designated using the letters *a* and *b*. Sites 10a through 17a, which are addressed in this section, include strategic remediation of creek crossings, with disturbance of the creek limited to what is necessary to remove localized sedimentation at the crossings. Sites 10b through 17b include more comprehensive sediment removal in the creek, and are addressed separately in later sections.

Existing Site Conditions

Site No. 10a: Building 1854 Culvert Crossing (Figure 22)

There are two 42" diameter reinforced concrete pipes at this crossing. One pipe is partially collapsed, and there appears to be little flow through the other pipe. There is significant erosion off of the tank trail directly into the creek on the sides of the crossing.

Site No. 11a: Main Service Road Culvert Crossing (Figure 23)

There are three 54" diameter reinforced concrete pipes at this crossing. While the culverts appear to be in fair condition, the outside pipes are more than 50 percent blocked with sediment and the center pipe appears to be approximately 30 percent blocked.

Site No. 12a: Building P804 Culvert Crossing (Figure 24)

There appear to be two reinforced concrete culverts, approximately 60 inches in diameter at this crossing. During several field visits, there was no visible flow, and the culverts were submerged. There is visible evidence of road overtopping. It is assumed that the culverts are almost completely blocked.

Site No. 13a: Sneads Ferry Road Culvert Crossing (Figure 25)

There are two 60" diameter reinforced concrete pipes at this crossing. The pipes were completely submerged during field visits, so the condition is unknown.

Site No. 14a: At-Grade Crossing 2 (Figure 26)

Cogdel's Creek is blocked where heavy vehicles have been driving through the creek. Berms have formed from sand thrown up as the vehicles cross, and significant erosion occurs from the trails leading to the crossing.

Site No. 15a: At-Grade Crossing 1 (Figure 27)

Cogdel's Creek is blocked where heavy vehicles have been driving through the creek. Berms have formed from sand thrown up as the vehicles cross, and significant erosion occurs from the trails leading to the crossing. In addition, a man-made ditch has been dug downstream of the crossing to drain the area more effectively. It appears that the ditch is regraded frequently.

Site No. 16a: At-Grade Crossing 4 (Figure 28)

This crossing is much deeper than the other three at-grade crossings, and so does not impede flow as significantly. It is possible that, with removal of the other creek obstructions, and discontinued use, this crossing would disappear through natural creek erosion/redeposition processes.

Site No. 17a: At-Grade Crossing 3 (Figure 29)

Cogdel's Creek is blocked where heavy vehicles have been driving through the creek. Berms have formed from sand thrown up as the vehicles cross, and significant erosion occurs from the trails leading to the crossing.

Site No. 18: ORRV Tributary Crossings

This site is located just north of Cogdel's Creek, and is accessed from locations near the MT/ENG building or from Sneads Ferry Road adjacent to Site 9. During field visits, two crossings of the tributary were observed at the southwest end of the area. Based on the size of the area, for the purpose of developing costs, it is assumed that there are a total of five similar creek crossings.

Remediation Plan (Sites 10a-13a)

- Clean out culverts as needed.
- Repair culverts and headwalls as needed. (Site 10)
- Stabilize the edges of crossing to prevent erosion. (Site 10)
- Restore the channel cross-section for 50 feet upstream and 50 feet downstream of culverts, including inlet and outlet protection.

Remediation Plan (Sites 14a-17a)

- Restore the channel cross-section for an 80-foot stream segment at the crossing (150 feet for Site 17), including removal of the sediment forming the crossing.
- Remove the man-made ditch downstream of the crossing. (Site 15)
- Revegetate a buffer for 80 feet on both sides of the creek (150 feet for Site 17).
- Install pilings or other roadblocks to prevent use of the crossing.

Remediation Plan (Site 18)

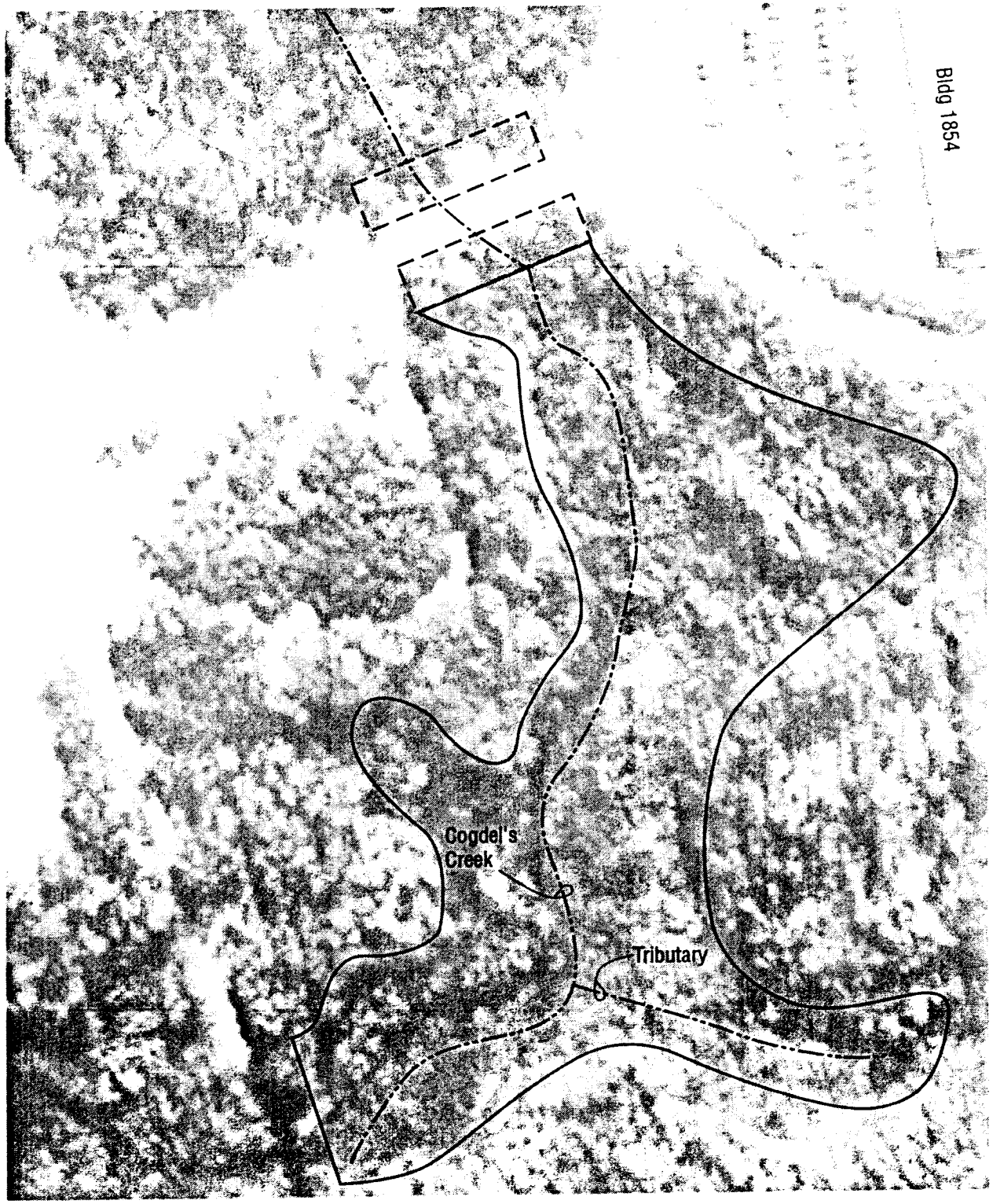
- Restore the channel cross-section at all locations where off-road recreational vehicles (ORRVs) have crossed the channel.
- Revegetate a buffer for 20 feet on both sides of tributary at crossings.
- Install pilings or other roadblocks to prevent use of crossing areas.
- Provide maps and educational materials to base personnel with guidelines for ORRV trail use, emphasizing the importance of remaining on trails and not driving through streams.

Maintenance Requirements

- Inspect and repair/revegetate areas damaged by stormwater following construction.
- Inspect culverts annually or after heavy storms to identify debris or sediment blockages. Remove debris or sediment as necessary.

Short-Term Measures

- Clear any debris and/or vegetation from culvert openings.
- As listed under Site 2 (tank trail), block at-grade crossings from traffic. Install traffic barriers at ORRV crossings and distribute information clarifying the areas ORRV use is allowed.
- Berm bare areas adjacent to creek to prevent erosion directly into the stream, allowing water to pond behind the berms.



North

0 200

SCALE IN FEET

Strategic Remediation Project Boundary

Comprehensive Remediation Project Boundary

Figure 22

Site 10: Buildling 1854 Culvert Crossing

Cogdel's Creek

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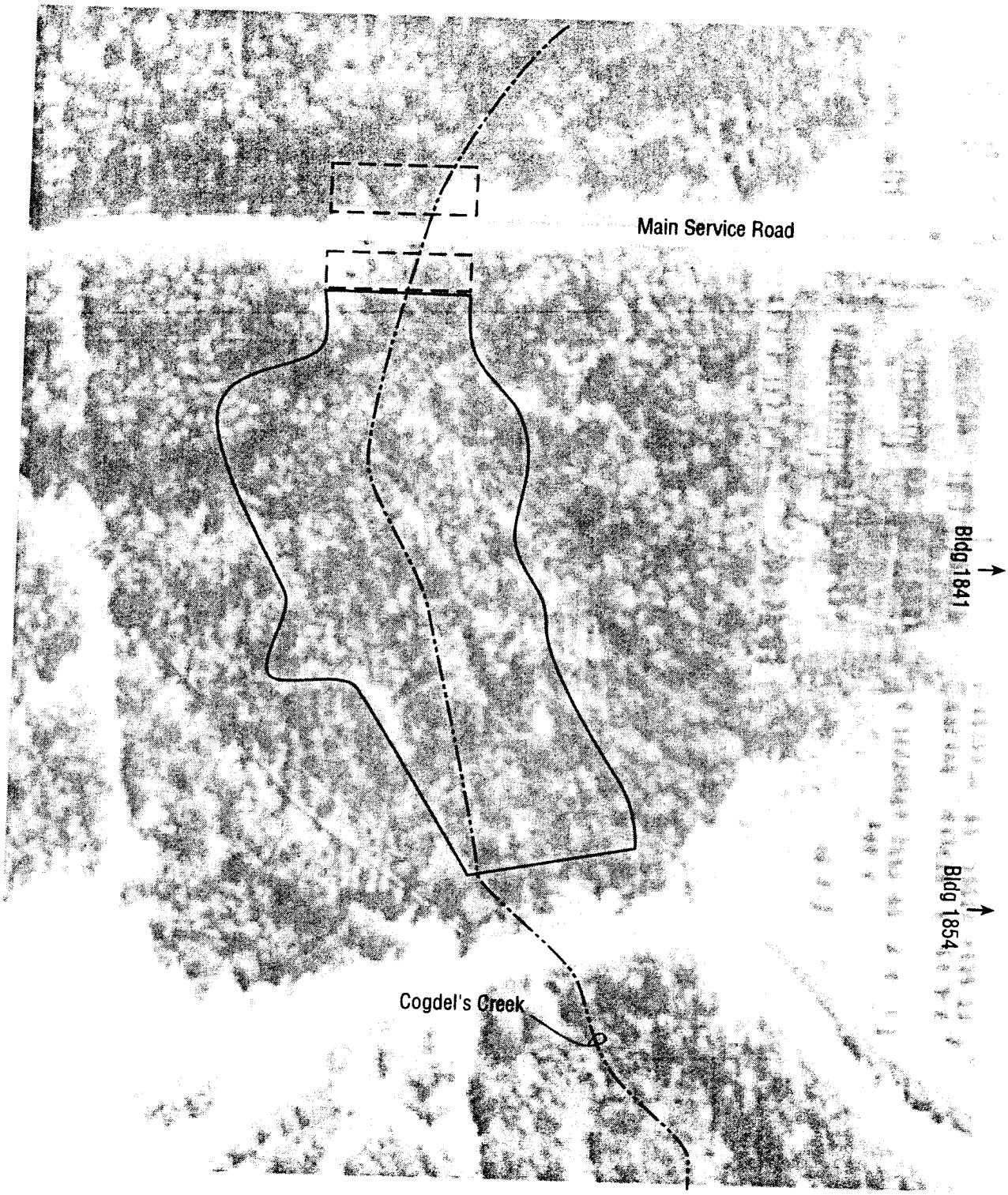

North

0 200

SCALE IN FEET

Strategic Remediation Project Boundary

Comprehensive Remediation Project Boundary

Figure 23

Site 11: Main Service Road Culvert Crossing

Cogdel's Creek

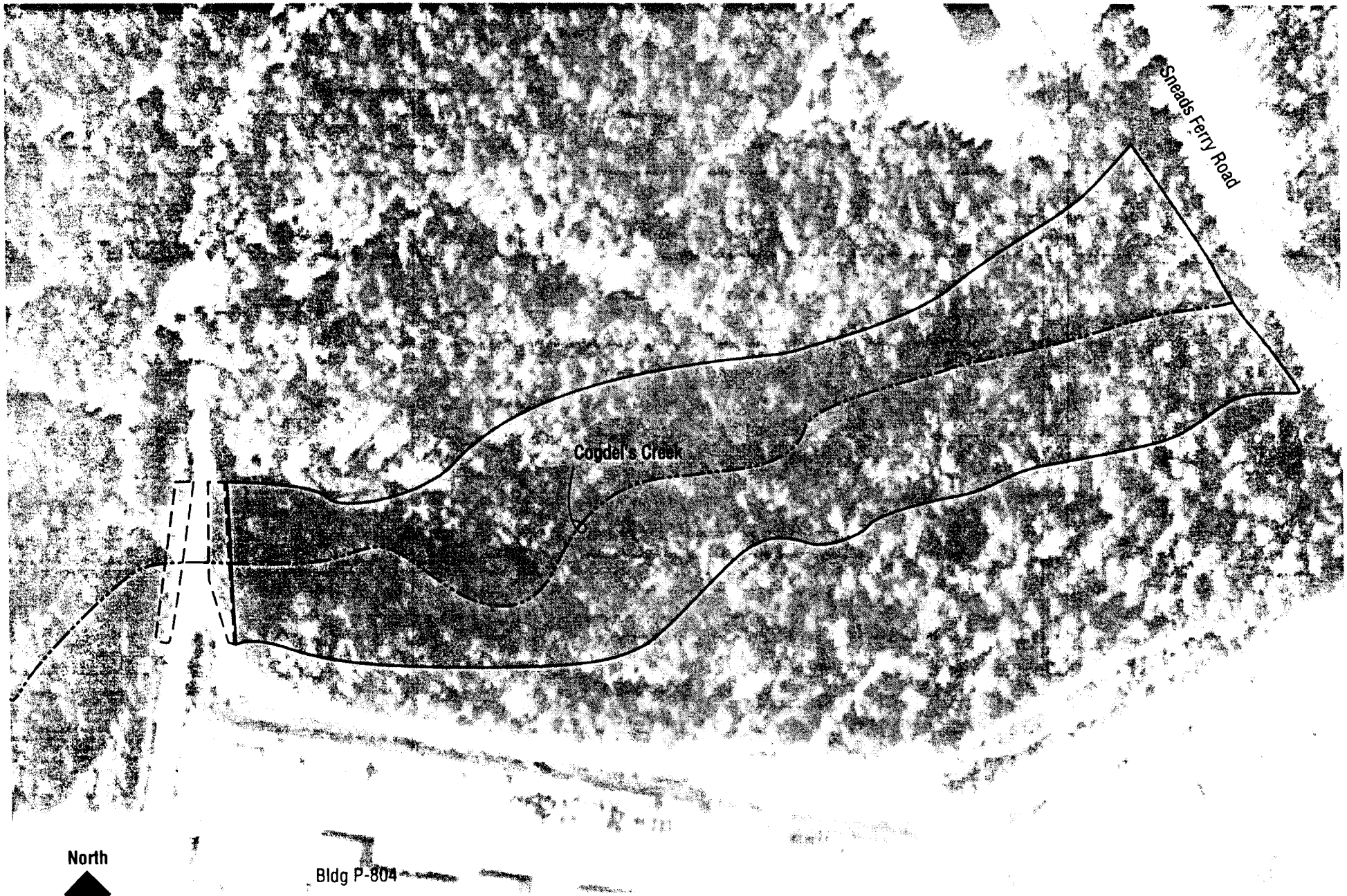

Figure 24

Site 12: Building P-804 Culvert Crossing

Cogdel's Creek

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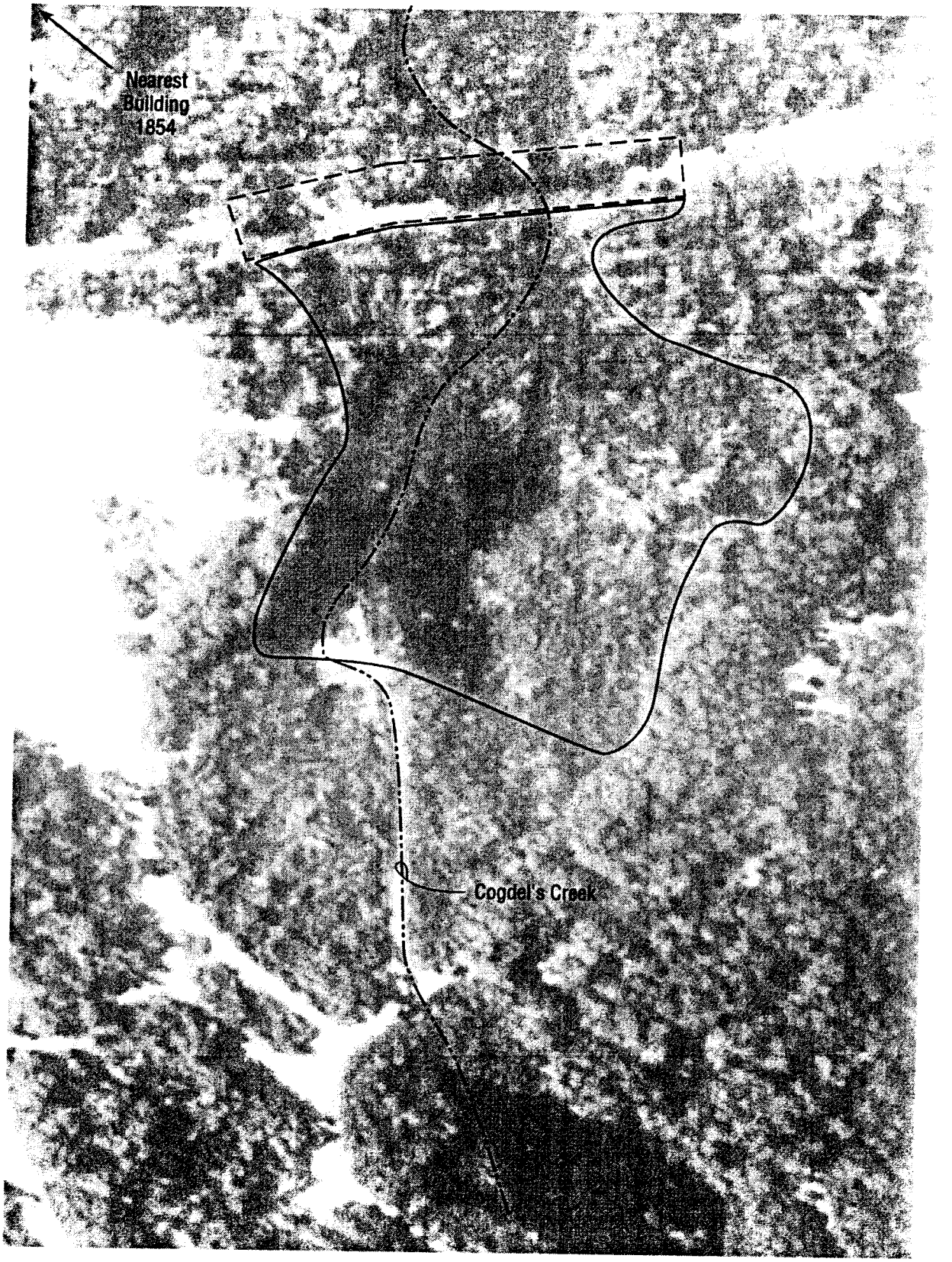

North

0 200

SCALE IN FEET

Strategic Remediation Project Boundary

Comprehensive Remediation Project Boundary

Figure 26

Site 14: At-grade Crossing 2

Cogdel's Creek

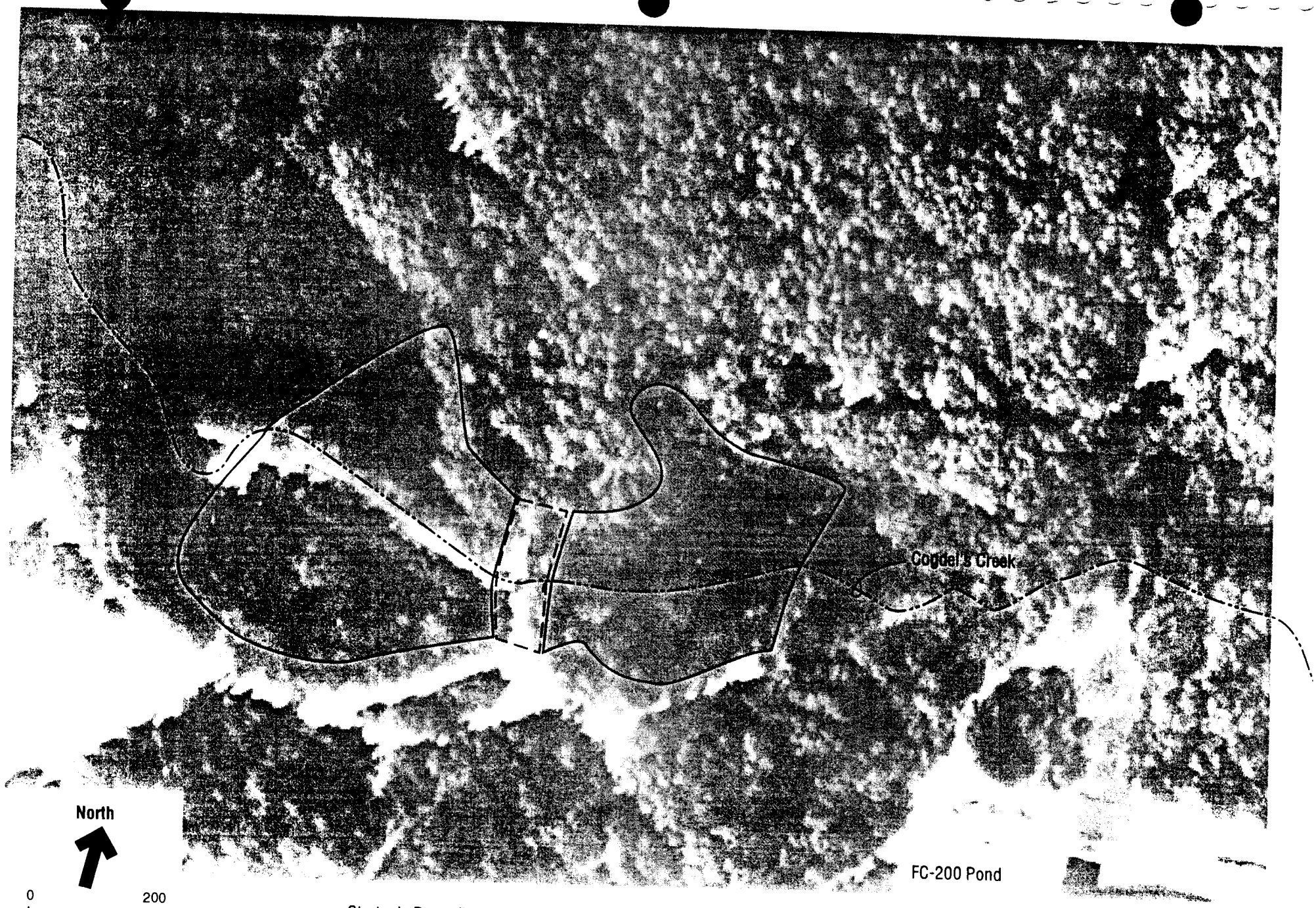

Figure 27
Site 15: At-grade Crossing 1
Cogdel's Creek

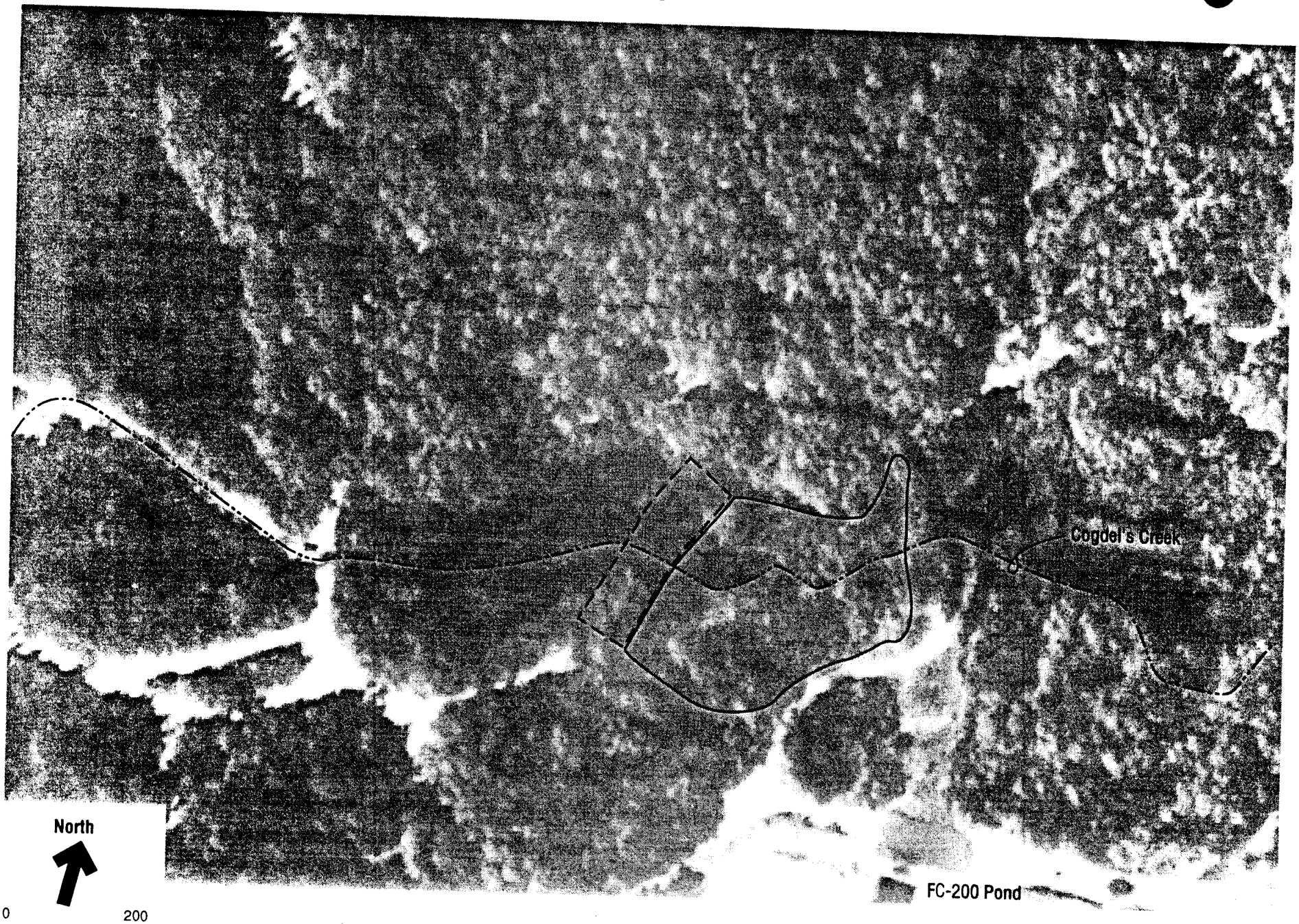

Figure 28
Site 16: At-grade Crossing 4
Cogdel's Creek

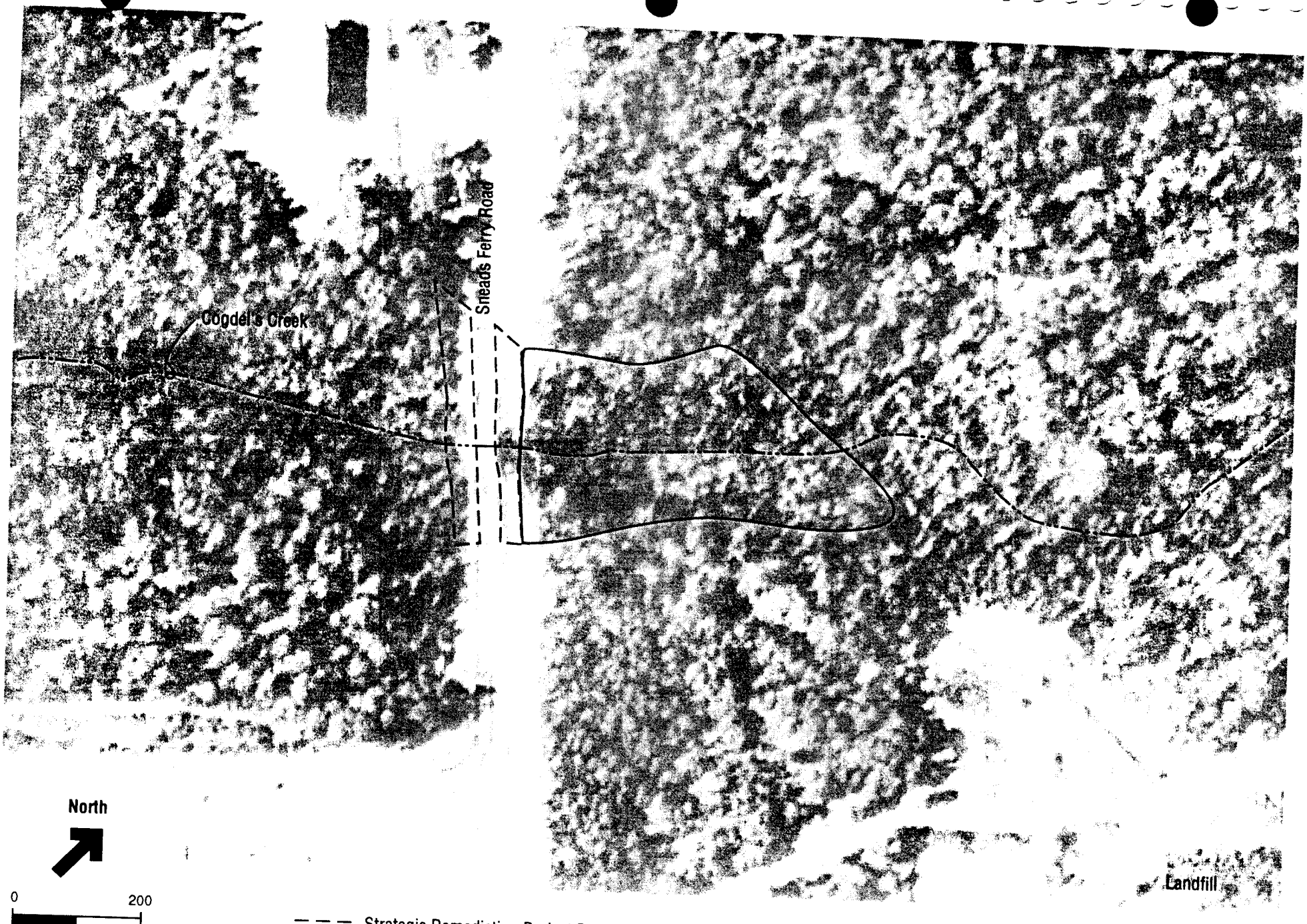

Figure 25

Site 13: Sneads Ferry Road Culvert Crossing

Cogdel's Creek

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CH2MHILL

Figure 29
Site 17: At-grade Crossing 3
Cogdel's Creek

W142842.A0.EV Fig 6 8-13-98 ttt

CH2MHILL

Site No. 10b: Upstream of Building 1854 Culvert Crossing

Existing Site Conditions

The site is shown in Figure 12. Sedimentation has occurred upstream of the culvert due to the culvert restriction. Based on observed water surface elevations, culvert inverts and sizes, and top of road elevations, it is estimated that this segment of stream probably has an average sediment depth of one foot.

Remediation Plan

- Restore the channel cross-section and profile for 1,300 feet upstream of the culverts.
- Provide wetland mitigation as needed.

Maintenance Requirements

- Inspect and repair revegetated areas and repair as necessary until vegetation is established along streambanks.

Site No. 11b: Upstream of Main Service Road Culvert Crossing

Existing Site Conditions

The site is shown in Figure 14. Sedimentation has occurred upstream of the culvert due to the culvert restriction. Based on observed water surface elevations, culvert inverts and sizes, and top of road elevations, it is estimated that this segment of stream probably has an average sediment depth of two feet.

Remediation Plan

- Restore the channel cross-section and profile for 850 feet upstream of the culverts.
- Provide wetland mitigation as needed.

Maintenance Requirements

- Inspect and repair revegetated areas and repair as necessary until vegetation is established along streambanks.

Site No. 12b: Upstream of Building P804 Culvert Crossing

Existing Site Conditions

The site is shown in Figure 15. Sedimentation has occurred upstream of the culvert due to the culvert restriction. Based on observed water surface elevations, culvert inverts and sizes, and top of road elevations, it is estimated that this segment of stream probably has an average sediment depth of three feet.

Remediation Plan

- Restore the channel cross-section and profile for 1,600 feet upstream of the culverts.
- Provide wetland mitigation as needed.

Maintenance Requirements

- Inspect and repair revegetated areas and repair as necessary until vegetation is established along streambanks.

Site No. 13b: Sneads Ferry Road Culvert Crossing

Existing Site Conditions

The site is shown in Figure 16. Sedimentation has occurred upstream of the culvert due to the culvert restriction. Based on observed water surface elevations, culvert inverts and sizes, and top of road elevations, it is estimated that this segment of stream probably has an average sediment depth of three feet.

Remediation Plan

- Restore the channel cross-section and profile for 500 feet upstream of the culverts.
- Provide wetland mitigation as needed.

Maintenance Requirements

- Inspect and repair revegetated areas and repair as necessary until vegetation is established along streambanks.

Site No. 14b: At-Grade Crossing 2

Existing Site Conditions

The site is shown in Figure 17. Sedimentation has occurred upstream of the crossing due to the restriction in flow. Based on observed water surface elevations and nearby floodplain elevations, it is estimated that this segment of stream probably has an average sediment depth of two feet.

Remediation Plan

- Restore the channel cross-section and profile for 700 feet upstream of the crossing.
- Provide wetland mitigation as needed.

Maintenance Requirements

- Inspect and repair revegetated areas and repair as necessary until vegetation is established along streambanks.

Site No. 15b: At-Grade Crossing 1

Existing Site Conditions

The site is shown in Figure 18. Sedimentation has occurred upstream of the crossing due to the restriction in flow. Based on observed water surface elevations and nearby floodplain elevations, it is estimated that this segment of stream probably has an average sediment depth of two feet.

Remediation Plan

- Restore the channel cross-section and profile for 400 feet upstream and 400 feet downstream of the crossing.
- Provide wetland mitigation as needed.

Maintenance Requirements

- Inspect and repair revegetated areas and repair as necessary until vegetation is established along streambanks.

Site No. 16b: At-Grade Crossing 4

Existing Site Conditions

The site is shown in Figure 19. Sedimentation has probably occurred upstream of the crossing due to the restriction in flow. Based on observed water surface elevations and nearby floodplain elevations, it is estimated that this segment of stream probably has an average sediment depth of one foot.

Remediation Plan

- Restore the channel cross-section and profile for 350 feet upstream of the crossing.
- Provide wetland mitigation as needed.

Maintenance Requirements

- Inspect and repair revegetated areas and repair as necessary until vegetation is established along streambanks.

Site No. 17b: At-Grade Crossing 3

Existing Site Conditions

The site is shown in Figure 20. Sedimentation has probably occurred upstream of the crossing due to the restriction in flow. Based on observed water surface elevations and nearby floodplain elevations, it is estimated that this segment of stream probably has an average sediment depth of two feet.

Remediation Plan

- Restore the channel cross-section and profile for 550 feet upstream of the crossing.
- Provide wetland mitigation as needed.

Maintenance Requirements

- Inspect and repair revegetated areas and repair as necessary until vegetation is established along streambanks.

Phasing

In general, projects should be sequenced from upstream to downstream. Otherwise, there is the risk that disturbance from remediation activities could cause sedimentation at a project site just completed downstream. It may be tempting to address stream crossing sites first (Sites 10a through 17a and 18), since the costs are a small portion of the total watershed cost. However, without completing erosion control projects first, sedimentation will continue to occur in Cogdel's Creek. This would result in reforming of blockages in the culverts, and ultimately increase the frequency of required culvert cleaning.

Table 13 presents a proposed phasing for the projects, based on the upstream/downstream relationships, the impact on Cogdel's Creek, and the potential for intermediate measures that can reduce impacts. As discussed earlier, all comprehensive restoration (Sites 10b through 17b) would potentially be done after the projects in Table 13 are completed and the impact of those improvements assessed, and would need to be done in upstream-to-downstream order.

Discussions to date have indicated that funding for the projects shown in Table 13 may be available over a 10-year time frame, or longer.

Table 14. Remediation Project Phasing
Cogdel's Creek Watershed

Phasing Order	Site No.	Location	Project Description
1	5	Landfill Area	Inspect and repair sediment pond if needed. Review completion plan to ensure erosion minimized
2	13a	Sneads Ferry Road Culvert Crossing	Clean out and repair culverts and immediately adjacent stream channel
3	12a	Building P804 Culvert Crossing	Clean out and repair culverts and immediately adjacent stream channel
4 [1]	3	FC-100 Area	Pave 50%, add pond, regrade, extend storm sewer, add grassed swales
4 [1]	4	FC-200 Area	Pave 90%, enlarge pond, improve outlet, add storm sewers
4 [1]	9	Fenced Area Near Sneads Ferry Road	Install vegetated buffer, regrade unvegetated areas
5	2	Tank Trail Area	Add improved tank trail, revegetate sand areas, limit access
6	17a	At-Grade Crossing 3	Eliminate crossing, restore channel cross-section
7	16a	At-Grade Crossing 4	Eliminate crossing, restore channel cross-section
8	15a	At-Grade Crossing 1	Eliminate crossing, restore channel cross-section
9	14a	At-Grade Crossing 2	Eliminate crossing and ditch, restore channel cross-section
10 [1]	7	Building 1450 Area	Repair/rebuild pipe inlets to pond, revegetate, regrade, enlarge pond to handle area north of Louis Road
10 [1]	8	MT/ENG Building Area	Construct sediment pond east of building, armor ravine, revegetate bare areas
10 [1]	18	ORRV Tributary Crossings	Eliminate crossings, restore channel cross-section
11	10a	Building 1854 Culvert Crossing	Clean out and repair culverts and immediately adjacent stream channel
12 [1]	6	Building 1775 Area	Vegetate buffer, add sand trap inlets, regrade
13	11a	Main Service Rd. Culvert Crossing	Clean out and repair culverts and immediately adjacent stream channel
14 [1]	1	G816 Area	Pave 30%, add storm drains w/sand traps, revegetate

[1] These projects are not downstream of any other projects and can be done earlier. If short-term measures to control off-site erosion are implemented, these projects can be completed concurrent with other projects.

Long-term Watershed Management

This section addresses long-term management issues that will reduce erosion and sedimentation. While some issues are specific to observations of problems in the Cogdel's Creek watershed, most can be applied base-wide to prevent or reduce problems in other watersheds as well.

Source Control

These practices will help MCB Camp Lejeune incorporate best management practices into the existing stormwater management system. The intent is to incorporate the standard practices over time to reduce sediment load to Cogdel's Creek. Some of the practices have already been identified for major sediment source areas in the site-specific projects, but should be extended over time to address the whole watershed.

Stormwater Inlet Identification

The stormwater inlet is the primary source for delivery of sediment and associated pollutants into the system. Once in the storm sewer system, the sediment is rapidly transported to the surface drainage system, which is in this case Cogdel's Creek. A comprehensive program to control sediment begins with an inventory of stormwater inlets. In this case, an inlet refers generically to catch basins, inlets, and open-ended storm sewers that take stormwater flow into the storm sewer system. The inventory should include the type and location of the inlet along with features in the vicinity of the inlet that indicate a need for or have the potential to control sediment. This could be expanded to include surveying of sizes and invert elevations for use in developing a stormwater management master plan.

Vegetation Program

Open soil surfaces are particularly susceptible to erosion, often producing sediment that moves down hill and eventually reaches the surface drainage system. Vegetation significantly reduces the potential for erosion and can be a positive factor in removing sediment from stormwater. Existing bare areas with the potential for erosion and sediment delivery should be identified and scheduled for the appropriate vegetative treatment. Some of these areas have been addressed in the site-specific projects in the remediation plan. Certain unvegetated areas such as internally drained areas may not contribute sediment load to the storm sewer and surface drainage system. Those areas do not require vegetation for sediment control.

Vehicle Traffic Confinement

Many of the trucks and automobiles on MCB Camp Lejeune are capable of traveling off road. The open character of the base and generally unconfined roadways provide many opportunities to drive off of paved surfaces for parking, short cuts or recreation. Vehicles can easily damage vegetation in these areas. Recovery time for damaged vegetation can be extensive due to the dry and sandy nature of the soils. Open soil areas along roadways can

be highly erosive, producing sediment that is efficiently delivered to the surface water system. Such erosion can also cause damage to the roadway.

The road system should be reviewed to identify areas that have a high potential for erosion and sediment delivery. Paved surfaces should be well marked and confined to contain traffic. Curbed roads with vertical curbs provide good confinement of traffic. Mountable curbs are less confining. Gravel shouldered roads provide an easy transition to vegetated surfaces and erosive soil surfaces adjacent to roads. In heavily traveled areas gravel shouldered roads may require barricades or other barriers to contain traffic. Dirt roads require special design considerations to reduce erosion and confine sediment.

Recreational Vehicle Use

There are a significant number of trails used by recreational vehicles. These include 4-wheel drive vehicles, motorcycles, and all terrain vehicles. As with dirt roads, these trails require special design considerations to prevent them from becoming a direct source of sediment to surface drainage systems. Stream crossings should not be allowed, since they provide an erosive channel sloped directly to the stream.

The base should review its recreational trail system to determine the extent and location of existing trails, how much trail is required, which trails have the greatest potential to deliver sediment, and which trails should be abandoned or extended to meet the base recreational needs and protect streams.

Pedestrian Trail Routing

The central base area is connected by pedestrian trails. These trails serve as pedestrian transit routs as well as recreational and physical conditioning trails. The trails are open soil, sometimes covered with chipped wood, bark, or gravel. The trails generally follow established roadways and are often on both sides of roadways. The base should review the condition of the pedestrian trail system to determine the potential for erosion and sedimentation particularly near stream crossings. In some locations the trails will require regrading and other stormwater management practices to avoid concentrating flow resulting in trail erosion. A non-erosive cover material or pavement in high traffic areas may be appropriate to protect the erosive soils. Consolidation of trails may also be appropriate to reduce the extent of exposed soil surfaces.

Pavement Sweeping

Paved surfaces often act as a direct flow path to the surface drainage system. In this situation it is very important that paved surfaces be swept regularly to reduce sediment delivery to streams. New stormwater management practices (best management practices) promote drainage of paved surfaces to vegetated surfaces for sediment removal before stormwater reaches a stream. In such cases frequent sweeping is not required.

Paved surfaces should be reviewed to determine where control measures are necessary to prevent sediment delivery to pavement and to determine where pavement sweeping will provide the greatest benefit.

Industrial Spill Prevention and Control

Camp Lejeune is partially a heavy industrial facility that requires the handling, use, and disposal of hazardous materials. An industrial spill prevention and control plan should be in place to reduce the potential for stream contamination.

Stormwater System Maintenance

An effective stormwater system will deliver clean stormwater from the urban areas without flooding. Regular system maintenance is required to provide this level of service.

Paved Surfaces

Paved surfaces should be monitored and swept as necessary to prevent delivery of sediment to the storm sewer system. The emphasis should be on areas that have direct access to storm sewer systems and perennial streams. The paved surface sweeping program should be linked to the traffic confinement and vegetation program to progressively reduce the areas that require sweeping. Sweeping equipment should be capable of effectively removing medium to fine sand from paved surfaces.

Roof Drains and Sump Pumps

Roof drains and sump pumps should be periodically checked and cleaned. Roof drains and sump pumps should discharge to vegetated surfaces to promote filtration of pollutants washed off of roof surfaces and to allow infiltration of stormwater to reduce the quantity of runoff. Energy dissipation is recommended at discharge points to slow velocity and prevent erosion.

Vegetated Surfaces

Vegetated surfaces should be monitored to ensure a protective cover for soil. Steep slopes, areas adjacent to paved surfaces, and drainage ditches should be targeted for more frequent monitoring and, if necessary, maintenance. Erosive areas that are chronically unvegetated may require more aggressive treatment to prevent erosion. Treatment such as erosion matting and mulching along with seeding or planting may be required to establish a healthy vegetative cover. Regrading may be required if slopes are excessive. Barricades may be required to deter vehicle and pedestrian traffic. Non-erosive ground cover materials such as aggregate or shredded wood and bark may also be considered.

Infiltration Areas

The majority of the base is covered by medium to fine sand with a relatively high infiltration rate. This feature offers great opportunities for stormwater volume reduction and water quality improvement. Flat and internally drained areas provide the greatest potential for infiltration, making them valuable stormwater management elements. Existing infiltration areas and internally drained areas should be periodically inspected to ensure their continued function. New infiltration areas should be incorporated into plans for base development.

Stormwater Inlets and Storm Sewers

Some of the practices listed above are geared toward keeping sediment from entering the storm sewer system; however there are some inlets that trap heavy sediment particles before they enter the pipe network. They can be cleaned relatively easily with surface equipment. Stormwater pipes should be periodically inspected for sediment buildup and if necessary cleaned to maintain their hydraulic capacity.

Sediment Basins

Sediment basins should be inspected annually and after major storms to monitor sediment buildup and structural condition. Sediment removal is required every 2 to 10 years, with the frequency dependant on the sediment delivery rate and pond efficiency. A healthy deep-rooted non-woody vegetated cover should be maintained on lagoon side slopes and embankments to prevent erosion and structural deterioration. Outlet structures should be checked annually and after storms, and cleaned of debris and obstructions.

Receiving Stream Maintenance

This section includes maintenance activities for manmade drainageways in developed areas of the base. It also includes some activities in natural perennial streams that are considered waters of the United States and are therefore regulated by the state and the US Army Corps of Engineers. Maintenance activity in these areas may require a permit.

Outfall Erosion Protection

Stormwater outfalls should be inspected annually and after significant storms. Pipe separation, undercutting, stream bank erosion and debris in the vicinity of the outfall should be checked. If deficiencies are found it is necessary to prepare and implement a plan to resolve the problem and avoid its reoccurrence. If sediment is deposited in the vicinity of the outfall it may be necessary to look upstream to identify and control the source of sediment.

Stream Culvert Cleaning

Early observations of the watershed have identified significant sediment buildup in culverts that cross Cogdel's Creek and its tributaries. This buildup has reduced the capacity of culverts and generally raised water levels and slowed the natural flow rate of the watershed. Annual inspection and cleaning of stream culverts is recommended.

Debris Removal

Streams in a natural state have developed vegetative mechanisms to limit or filter out obstructions to flow. With urban development, multiple road crossings and recreational activities adjacent to the stream, the natural filtering mechanisms are diminished. Add to that the new source of urban debris and the potential for stream clogging is significantly increased. Streams should be inspected annually and after significant storms, and debris removed.

Attachment A: Soil Series Descriptions

LOCATION ONSLOW NC+SC

Established Series
Rev. WLB:JCJ:VL
10/86

ONSLOW SERIES

The Onslow series consists of moderately well drained and somewhat poorly drained soils that formed from moderately fine-textured Coastal Plain sediments. These soils are on nearly level to slightly convex divides of uplands. Slopes range from 0 to 3 percent.

TAXONOMIC CLASS: Fine-loamy, siliceous, thermic Spodic Paleudults

TYPICAL PEDON: Onslow loamy fine sand, on a nearly level convex divide in woods. (Colors are for moist soil unless otherwise stated.)

A--0 to 4 inches; very dark gray (10YR 3/1) loamy fine sand; weak medium granular structure; very friable; many fine roots; very strongly acid; clear wavy boundary. (3 to 6 inches thick)

E--4 to 8 inches; gray (10YR 6/1) loamy fine sand; weak medium granular structure; very friable; common fine roots; very strongly acid; clear wavy boundary. (0 to 7 inches thick)

E/Bh--8 to 14 inches; very pale brown (10YR 7/3), light yellowish brown (10YR 6/4), and reddish brown (5YR 5/4) loamy fine sand; massive; very friable to firm; about 1/3 of the horizon is weakly cemented Bh and 1/3 is strongly cemented Bh concretions ranging from 1/4 to 3/4 inch in size; few fine roots; very strongly acid; clear wavy boundary. (3 to 8 inches thick)

E'--14 to 17 inches; very pale brown (10YR 7/3) loamy fine sand; weak medium granular structure; very friable; few fine roots; very strongly acid; clear wavy boundary. (0 to 10 inches thick)

BE--17 to 20 inches; brownish yellow (10YR 6/6) fine sandy loam; few coarse distinct very pale brown (10YR 7/3) mottles; weak fine subangular blocky structure; very friable; few fine roots; very strongly acid; clear wavy boundary. (0 to 4 inches thick)

Bt1--20 to 30 inches; brownish yellow (10YR 6/6) sandy clay loam; few medium distinct strong brown (7.5YR 5/8), and light gray (10YR 7/1) mottles; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few medium roots; few thin clay films on faces of peds; very strongly acid; gradual wavy boundary. (6 to 15 inches thick)

Bt2--30 to 41 inches; mottled light yellowish brown (10YR 6/4), strong brown (7.5YR 5/8), and light gray (10YR 7/2) sandy clay loam;

weak medium subangular blocky structure; friable; slightly sticky, slightly plastic; few thin clay films on faces of peds; very strongly acid; gradual wavy boundary. (8 to 15 inches thick)

Btg--41 to 53 inches; light gray (10YR 7/2) sandy clay loam; common medium distinct brownish yellow (10YR 6/8), and few fine prominent yellowish red (5YR 5/8) mottles; weak medium subangular blocky structure; friable, slightly sticky, slightly plastic; few thin clay films on faces of peds; very strongly acid; gradual wavy boundary. (5 to 14 inches thick)

BCg--53 to 68 inches; light gray (10YR 7/1, 6/1) sandy clay loam with lenses of sandy loam; common medium distinct yellowish red (5YR 5/8) mottles; weak subangular blocky structure; friable; slightly sticky; few small bodies of clean sand; very strongly acid; gradual wavy boundary. (7 to 20 inches thick)

Cg--68 to 80 inches; white (10YR 8/1) sandy loam with common lenses of loamy sand; few medium distinct light yellowish brown (10YR 6/4) and brownish yellow (10YR 6/8) mottles; massive; friable; very strongly acid.

TYPE LOCATION: Onslow County, North Carolina; 0.6 mile southwest of Swansboro, 0.3 mile north of intersection of SR 1444 and SR 1447, 100 feet east of SR 1444.

RANGE IN CHARACTERISTICS: The loamy textured horizons extend to 60 inches or more below the soil surface. The reaction ranges from strongly acid to extremely acid in all horizons except where the surface has been limed.

The A or Ap horizon has hue of 10YR to 5Y, value of 3 to 5, and chroma of 1 to 3.

The E horizon, where present, has hue of 10YR to 5Y, value of 5 to 7, and chroma of 1 to 4.

The E portion of the E and Bh horizon has hue of 10YR or 2.5Y, value of 4 to 8, and chroma of 3 to 6. The Bh portion has hue of 10YR, 7.5YR or 5YR, value of 2 to 5, and chroma of 2 to 4. It is discontinuous and ranges from 15 to 75 percent of the E/Bh horizon. Weakly to strongly cemented Bh concretions range from 15 to 35 percent of the Bh portion of this horizon. In some pedons the Bh horizon is destroyed by tillage but the Bh concretions remain in the plow layer as evidence of this horizon.

The E' horizon, where present, has hue of 10YR to 5Y, value of 5 to 8, and chroma of 2 to 4. The A, E, and E/Bh horizons are loamy fine sand, fine sandy loam, loamy sand, and sandy loam.

The BE horizon where present, has hue of 10YR to 5Y, value of 5 to 7, and chroma of 3 to 8. It is fine sandy loam, sandy loam, or sandy clay loam.

The Bt horizon has hue of 10YR to 5Y or rarely 7.5YR, value of 5 to 8, and chroma of 3 to 8 or is mottled in shades of these colors. Mottles in shades of gray, brown, and red are in most pedons with a dominant matrix color.

The Btg and BCg horizons have hue of 10YR to 5Y, value of 5 to 8, and chroma of 1 to 2. Mottles in shades of yellow, brown, and red are in most pedons. The Bt, Btg, and BCg horizons are sandy clay loam, clay loam, fine sandy loam, and sandy loam.

The Cg horizon has hue of 10YR to 5Y, value of 5 to 8, and chroma of 1 to 3. Mottles in shades of yellow and brown are in some pedons. It is sandy clay loam, clay loam, sandy loam, loamy sand, and sand or is stratified with these textures. Some pedons have clayey or silty IIC horizons.

COMPETING SERIES: There are no other series in this family. Those closely related families are the Baymeade, Craven, Foreston, Goldsboro, Leon, Mandarin, Mascotte, and Seagate series. Baymeade and Seagate soils have arenic surface layers. Craven, Foreston, and Goldsboro soils do not have spodic horizons. Leon, Mandarin, and Mascotte soils have a continuous spodic horizon and in addition, Leon and Mandarin soils lack an argillic horizon.

GEOGRAPHIC SETTING: Onslow soils are on slightly convex interstream divides in the lower Coastal Plain. Slopes range from 0 to 3 percent. They formed in loamy Coastal Plain sediments at elevations of about 20 to 65 feet above sea level. Average annual precipitation is about 50 inches and mean annual temperature is 63 degrees F. near the type location.

GEOGRAPHICALLY ASSOCIATED SOILS: In addition to the competing series, these are the Autryville, Echaw, Lenoir, Lynchburg, Pactolus, Rains, Stallings, and Wrightsboro series. Except for the Echaw, none of the soils have a spodic horizon. Echaw soils are sandy and have a continuous spodic horizon at a depth of 30 to 50 inches.

DRAINAGE AND PERMEABILITY: Moderately well drained and somewhat poorly drained; slow runoff; moderate permeability. The seasonal high water table is about 18 inches below the surface for 2 to 4 months in most years.

USE AND VEGETATION: About 2/3 of the acreage is cleared and used for crops, pasture, or urban. Main crops grown are corn, soybeans, and tobacco. Native woodland species include loblolly pine, longleaf pine, red oak, white oak, water oak, hickory, sweetgum, red maple, holly, dogwood, and sweetbay.

DISTRIBUTION AND EXTENT: Lower Coastal Plains of North Carolina, South Carolina, Virginia, and possibly Georgia and Florida. The series is inextensive.

MLRA OFFICE RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: Onslow County, North Carolina, 1921.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - the zone from the surface to a depth of 8 inches (the A and E horizons).

Albic horizon - the zone from a depth of 4 to 8 inches (the E horizon - not required).

Argillic horizon - the zone from a depth of 20 to 68 inches.

National Cooperative Soil Survey
U. S. A.

LOCATION TORHUNTA NC+GA SC VA

Established Series
Rev. HJB:DLN
7/86

TORHUNTA SERIES

The Torhunta series consist of very poorly drained soils in upland bays and on stream terraces in Coastal Plain. Slopes range from 0 to 2 percent.

TAXONOMIC CLASS: Coarse-loamy, siliceous, acid, thermic Typic Humaquepts

TYPICAL PEDON: Torhunta fine sandy loam--cultivated.
(Colors are for moist soil unless otherwise stated.)

Ap--0 to 9 inches; black (10YR 2/1) fine sandy loam; weak medium granular structure; friable; many fine roots; strongly acid; abrupt wavy boundary. (0 to 12 inches thick.)

A--9 to 15 inches; very dark gray (10YR 3/1) loamy sand; weak medium granular structure; very friable; many fine roots; thin coats of organic matter on grains; very strongly acid; gradual wavy boundary. (4 to 15 inches thick.)

Bg--15 to 40 inches; dark grayish brown (10YR 4/2) fine sandy loam; weak fine subangular blocky structure; friable; slightly sticky and slightly plastic; many fine roots in upper part; thin silt coatings on sand grains; few loamy sand and sand pockets; extremely acid; gradual wavy boundary. (10 to 25 inches thick.)

Cg1--40 to 48 inches; dark grayish brown (10YR 4/2) loamy sand; common medium faint gray (10YR 5/1) and brown (10YR 5/3) mottles; single grained; very friable; few sand pockets; extremely acid; diffuse wavy boundary. (0 to 10 inches thick.)

Cg2--48 to 80 inches; grayish brown (10YR 5/2) sand; single grained; loose; uncoated sand grains; very strongly acid.

TYPE LOCATION: Wayne County, North Carolina; 1.5 miles south of New Hope; 0.4 mile northeast of intersection of Roads 1712 and 1713, 50 feet south of Road 1713 and 50 feet northeast of power line poles.

RANGE IN CHARACTERISTICS: Torhunta soil has loamy textured horizons that range from 20 to 50 inches thick. The soil reaction ranges from extremely acid through strongly acid, unless the surface has been limed.

The Ap or A horizon has hue of 10YR, 2.5Y, or it is neutral, value of 2 or 4, and chroma of 0 to 2. It is sandy loam, fine sandy loam, loam, loamy sand or their mucky analogues.

The Bg horizon has hue of 10YR, 2.5Y, or it is neutral, value of 4 to 6, and chroma of 0 to 2. Mottles are in shades of brown or yellow. It is sandy loam or fine sandy loam.

The BCg horizon, where present, has hue of 10YR, 2.5Y, or it is neutral, value of 4 to 7, and chroma of 0 to 2. Mottles are in shades of yellow or brown. It is sandy loam, fine sandy loam, loamy sand, or sand.

The Cg horizon has colors of the BCg horizon and in addition, has hue of 5GY or 5G, value of 4 to 6, and chroma of 1. It is loamy sand, loamy fine sand, sand, or sandy loam.

COMPETING SERIES: There are no other series in the same family. Arapahoe, Johnston, Mullica, Pickney, Pocomoke, Portsmouth, Rutlege, Weeksville, and Weston series are in closely related families. Arapahoe and Mullica have mixed mineralogy. Arapahoe is also nonacid. Johnston and Pickney soils have an umbric epipedon more than 24 inches thick. Pocomoke, Portsmouth, and Weston soils have argillic horizons. Rutlege soils are sandy throughout. Weeksville soils are coarse-silty.

GEOGRAPHIC SETTING: Torhunta soils are on nearly level stream terraces and upland bay areas in the Coastal Plain. Slope gradients are less than 2 percent. The soil formed in coarse to medium textured, marine or fluvial deposits. At the type location, mean annual temperature is 63 degrees F. and mean annual rainfall is about 48 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: In addition to the Rutlege series, these include Johns, Lumbee, Lynchburg, and Rains series. Johns, Lumbee, Lynchburg, and Rains soils have more than 18 percent clay in the Bt horizons and lack the thick, dark colored A horizons.

DRAINAGE AND PERMEABILITY: Very poorly drained; slow runoff; moderately rapid permeability. The water table is at or near the surface 2 to 6 months annually.

USE AND VEGETATION: Approximately 2/3 of these soils are in pine forest with pond and loblolly being the principal species. About 1/3 of the soil area has been drained and is used for growing corn, soybeans, small grain, and pasture grasses.

DISTRIBUTION AND EXTENT: Widely distributed over the Coastal Plain of Florida, Georgia, North Carolina, South Carolina, and Virginia. The series is extensive.

MLRA OFFICE RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: Robeson County, North Carolina; 1972.

Channel Inspection and Stabilization

Changing watershed conditions with development will have an impact on the natural stream channel. Certain stormwater management measures along with development can reduce impacts, but there will be a change in the delivery rate and volume of stormwater runoff. The stream channel will change in response to the watershed changes. To maintain the stream channel in its natural condition it may be necessary to provide some stream bank stabilization to control erosion. Such stabilization efforts should include natural vegetation and incorporate natural channel characteristics in the vicinity of the repair. Channel stabilization may require a permit.

Stormwater Requirements for New Development

Rate and Volume Control

Controlling the rate and volume of runoff from new development is important to maintain the natural character of the receiving stream. Stormwater storage and infiltration are essential elements of new stormwater systems to control the rate and volume of runoff. Infiltration can be particularly effective in the Cogdel's Creek watershed due to the high infiltration rate of the native soils of the watershed. These elements of storage and infiltration should be incorporated into site designs for new development and redevelopment.

Sediment Control

Sediment control in an inherent feature of stormwater storage and infiltration. By applying stormwater storage and infiltration for rate and volume control there will be significant control of sediment. The volume of trapped sediment and methods to remove it must be taken into consideration when designing storage and infiltration devices.

Vegetation as a filtering device is also an important element of sediment control. Runoff from new development areas should be directed where practical on an overland flow path to vegetated surfaces to reduce sediment delivery. This technique also reduces the rate of runoff and promotes infiltration.

Construction Erosion Control

In developing areas, sediment delivery during construction is often the largest single source of sediment in a watershed. Therefore construction erosion control with periodic inspection should be an essential element of new development.

Protection of Wetlands and the Flood Plain

Wetlands and floodplain associated with Cogdel's Creek provide important functions in preserving the natural character of the watershed. Wetlands represent a significant portion of the natural storage capacity of the watershed. They promote infiltration and retain and reduce pollutants in surface waters and runoff. Wetlands also provide valuable habitat for vegetation and wildlife.

Floodplains provide flood storage in balance with the runoff and conveyance capacity of the watershed. If floodplain storage is lost to development there will be an immediate

change in the watershed transferring lost storage to another location potentially causing flooding or increasing the conveyance capacity of the stream channel by erosion. Both changes are contrary to the objective of maintaining natural stream channel and watershed conditions. Wetland and floodplain protection should be essential requirements of new development.

Education

A key component of preventing erosion and sedimentation is simply making people aware of the causes and problems associated with sediment. Communication of the standard practices discussed above should be made to the following groups, so that they can incorporate this awareness into their existing activities:

- Environmental and Planning Department
- Public Works Staff
- Maintenance Staff
- Industrial Spill Prevention Staff
- Commercial/Industrial Tenants
- Military personnel at key sites
- Residents

Regulatory Requirements

A meeting was held to review the concepts of the Cogdel's Creek Remediation Plan with regulatory agencies on June 9, 1998. Regulatory agencies were represented by:

Tere Barrett	Division of Coastal Management
Mickey Sugg	U.S. Army Corps of Engineers
Eric Galamb	Division of Water Quality
Kevin Moody	US Fish and Wildlife Service

At the meeting, the agencies indicated that they could issue 8 to 10-year permits to allow phased implementation of the watershed remediation plan. This should be considered during the National Environmental Protection Act (NEPA) process, which is the next step in implementing the Cogdel's Creek Remediation Plan.

Major regulatory requirements that will need to be addressed are:

Stormwater Management (15A NCAC 2H .1000): This mainly affects the design of the site improvements, especially detention basins, for the upland areas (Sites 1, 3, 4, 6, 7, 8, and 9).

Sedimentation and Erosion Control (GS 113A-57): A sediment and erosion control plan must be submitted for the planned improvements, and must address any areas that will remain unvegetated.

Coastal Area Management (15A NCAC 07H .0200): CAMA only has jurisdiction over tidal areas and within navigable portions or the creek, so design requirements do not affect much of the project area. The environmental documentation will need to be detailed enough for review of hydrologic impacts.

Wetlands (15A NCAC 02B .0231): Removal of blockages in the stream (culverts and at-grade crossings) could lower the water table, so the environmental documentation will need to included a hydrologic analysis showing impacts to groundwater levels and associated wetland hydroperiods. Removal of at-grade crossings could constitute restoration of wetlands, and if overall benefits are favorable, mitigation requirements for other work in the stream could be reduced or eliminated.

Based on the above considerations, preparation of environmental documentation will require the following:

- Survey of stream cross-sections for hydrologic analysis and dredge-and-fill calculations
- Survey of major drainage structures for hydrologic analysis
- Wetland species cross-section survey and jurisdictional wetland boundary determination at in-stream project locations for use in determining wetland impacts
- Hydrologic analysis to evaluate flood and base flow impacts
- Groundwater analysis to evaluate wetland impacts.
- Preliminary design of erosion control sites in order to evaluate hydrologic impacts of new impervious areas, drainage structures, and sediment ponds.

The items above could be addressed most efficiently by developing a stormwater management master plan for the Cogdel's Creek watershed. The master plan would then serve as a basis for this remediation plan, as well as for anticipated NPDES Phase 2 stormwater requirements and for future development within the watershed. It is anticipated that the regulatory process may take about 12 months.

SOIL LEGEND

SYMBOL	NAME
BAB	Baymeade fine sand, O to 6 percent slopes
BMB	Baymeade-Urban land complex, 0 to 6 percent slopes
Ct	Croatan muck
KuB	Kureb fine sand, 1 to 6 percent slopes
Ln	Leon fine sand
MaC	Marvyn loamy fine sand, 6 to 15 percent slopes
Mk	Muckalee loam
Mu	Murville fine sand
ND	
NfC	Newhan fine sand, dredged, 2 to 10 percent slopes
On	Onslow loamy fine sand
Pa	Pactulus fine sand
Pt	Pits
St	Stalling loamy fine sand
To	Tovhunta fine sandy loam
Ud	Udorthents, loamy
Ur	Urban land
Wo	Woodington loamy fine sand

LEGEND OF SOIL ABBREVIATIONS

T' IRE:

st	- stones and stony	si	- sandy loam
k	- cobbles and cobbly	fsl	- fine sandy loam
g	- gravel and gravelly	vfsl	- very fine sandy loam
vcos	- very coarse sand	l	- loam
cos	- coarse sand	si	- silt
s	- sand	sil	- silt loam
fs	- fine sand	scl	- sandy clay loam
vfs	- very fine sand	cl	- clay loam
lcos	- loamy coarse sand	sicl	- silty clay loam
ls	- loamy sand	sc	- sandy clay
lfs	- loamy fine sand	sic	- silty clay
cosl	- coarse sandy loam	c	- clay

STRUCTURE:

Grade:

m	-	massive, no aggregation
sg	-	single grain, no aggregation
1	-	weak
2	-	moderate
3	-	strong

Size:

vf	-	very fine
f	-	fine
m	-	medium
c	-	coarse
vc	-	very coarse

Type:

gr	-	granular
cr	-	crumb
pl	-	platy
pr	-	prismatic
'or	-	columnar
)k	-	angular blocky
ubk	-	subangular blocky

BOUNDARY:

Distinctness:

va	-	very abrupt
a	-	abrupt
c	-	clear
g	-	gradual
d	-	diffuse

Topography:

s	-	smooth
w	-	wavy
i	-	irregular
b	-	broken

Permeability:

	Inches/hour
Very Slow	<0.06
Slow	0.06 - 0.2
Moderately Slow	0.02 - 0.6
Moderate	0.6 - 2.0
Moderately Rapid	2.0 - 6.0
Rapid	6.0 - 20.0
Very Rapid	>20.0

ROCKINESS: Rockiness refers to bedrock exposures or patches of soil too thin over bedrock for use.

Class 0: Less than 2% bedrock exposed.

Class 1: Bedrock exposures interfere with tillage and cover 2 to 10% of the surface. (Rocky)

Class 2: Bedrock exposures make tillage of intertilled crops impractical and cover 10 to 25% of the surface. (Very Rocky)

Class 3: Bedrock exposures prohibit use of all but light machinery and cover 25 to 50% of the surface. (Extremely Rocky)

Class 4: Bedrock exposures make all use of machinery impractical and cover 50 to 90% of the area. (Rock Type)

Class 5: Bedrock exposures occur over 90% of the surface. (Rock Type)

STONINESS: Stones are detached rock fragments and, if rounded, they are more than 10" in diameter, or if flattened, more than 17" along the long axis.

Class 0: Stones more than 100 feet apart and cover less than 0.01% of the area.

Class 1: Stones interfere with tillage. They are 30 to 100 feet apart, and cover 0.01 to 0.1% of the surface. (Stony)

Class 2: Stones make tillage of intertilled crops impracticable unless cleared. They occupy 0.1 to 3% of the area. (Very Stony)

Class 3: Practically all tillage with machinery is impracticable unless cleared. Stones occupy 3 to 15% of the surface. (Extremely Stony)

Class 4: Stones are so frequent that they are less than 2.5 feet apart and occupy 15 to 90% of the surface. (Stony Land)

Class 5: Land essentially paved with stones. (Stony Land)

COLOR (including mottles):

Abundance:
f - few (mottles <2% of surface area)
c - common (mottles 2 to 20% of surface area)
m - many (mottles >20% of surface area)

Size:
1 - fine, <5 mm in diameter
2 - medium, 5 to 15 mm in diameter
3 - large, >15 mm in diameter

Contrast:
f - faint
d - distinct
p - prominent

CONSISTENCE:

Dry Consistence:

lo	-	loose
so	-	soft
sh	-	slightly hard
h	-	hard
vh	-	very hard
eh	-	extremely hard

Moist Consistence:

lo	-	loose
vfr	-	very friable
fr	-	friable
fi	-	firm
vfi	-	very firm
efi	-	extremely firm

Wet Consistence:

so	-	nonsticky
ss	-	slightly sticky
s	-	sticky
vs	-	very sticky
po	-	nonplastic
ps	-	slightly plastic
p	-	plastic
vp	-	very plastic

CARBONATES:

vs	-	very slightly effervescent
s	-	slightly effervescent
es	-	strongly effervescent
ev	-	violently effervescent

REMARKS: Torhunta soils were formerly included in the Pocomoke series.

Diagnostic horizons and features recognized in this pedon are:

Umbric epipedon - the zone drom the surface to a depth of 15 inches. (The Ap and A horizons)

Cambic horizon - the zone between a depth of 15 to 40 inches.
(The Bg horizon)

Aquic moisture regime - chromas of 2 or less below a depth of 9 inches.

National Cooperative Soil Survey
U. S. A.

LOCATION KUREB NC+FL GA

Established Series
Rev. AW:AG
6/96

KUREB SERIES

The Kureb series consists of very deep, excessively drained, gently sloping to moderately steep soils on Coastal Plain uplands and on side slopes along streams and bays. They have formed in marine, aeolian, or fluvial sands. Slopes range from 0 to 20 percent. Near the type location mean annual precipitation is about 50 inches and mean annual temperature is about 63 degrees F.

TAXONOMIC CLASS: Thermic, uncoated Spodic Quartzipsamments

TYPICAL PEDON: Kureb sand--on a 4 percent slope under sparsely mixed hardwoods of turkey and bluejack oak and scattered longleaf pine. (Colors are for moist soil unless otherwise stated.)

A--0 to 3 inches; dark gray (10YR 4/1) sand; single grained; loose; organic matter and quartz grains have salt and pepper appearance; many fine and large roots; neutral; clear wavy boundary. (2 to 5 inches thick)

E--3 to 26 inches; light gray (10YR 7/1) sand; single grained; loose few large roots; neutral; clear irregular boundary. (4 to 45 inches thick)

C/Bh--26 to 51 inches; brownish yellow (10YR 6/6) sand; single grained; loose; few tongues of light gray (10YR 7/1) extend from above horizon; dark brown (7.5YR 4/4) and few bands and bodies (Bh) of dark reddish brown (5YR 3/2); bands are intermittent at horizon contact and vertically along walls of tongues; many clean and coated sand grains; neutral; gradual wavy boundary. (4 to 46 inches thick)

C--51 to 89 inches; pale brown (10YR 6/3) sand; single grained; loose, slightly acid.

TYPE LOCATION: New Hanover County, North Carolina; 1 3/4 miles south of U. S. 421 and N.C. 132 junction; 1/4 mile east and about 200 feet south.

RANGE IN CHARACTERISTICS: Thickness of the sandy horizons is more than 80 inches. Soil reaction is neutral to extremely acid throughout. All horizons are fine sand, sand, or coarse sand. Silt plus clay content is less than 5 percent.

The A horizon has hue of 10YR, value of 3 to 7, and chroma of 1 or 2.

The E horizon has hue of 10YR or 2.5Y, value of 5 to 8, and chroma of 1 to 3. Tongues of E horizon are in old root channels in the C/Bh horizon.

The C part of the C/Bh horizon has hue of 10YR or 2.5Y, value of 5 to 7, and chroma of 2 to 8. The Bh part of the C/Bh horizon has hue of 5YR to 10YR, value of 2 to 6, and chroma of 2 to 4.

The C horizon has hue of 7.5YR to 2.5Y, value of 4 to 8, and chroma of 1 to 8. Few to common mottles in shades of brown, yellow, or gray are in the C horizon of some pedons. Gray mottles are the result of uncoated sand grains and not wetness.

COMPETING SERIES: Resota series is the only soil in the same family. Alaga, Alpin, Cainhoy, Centenary, Corolla, Foxworth, Fripp, Kershaw, Lakehurst, Lakeland, Lakewood, Newhan, Orsimo, Ousley, Paola, Resota, Rimini, and Welaka series are in closely related families. Resota soils are moderately well drained and have seasonal high water table at depths of 40 to 60 inches. Alaga, Alpin, Corolla, Foxworth, Fripp, Kershaw, Lakeland, Newhan, Paola, and Wekaka soils lack an intermittent Bh horizon. In addition, Alaga soils have 10 to 25 percent percent silt plus clay in 10- to 40-inch control section. Alpin soils have lamella beginning at depths of 40 to 70 inches. Corolla and Newham soils are affected by salt spray. Lakeland soils have 5 to 10 percent silt plus clay in the 10- to 40-inch control section. Ousley soils have a seasonal watertable at 1.5 to 30 feet. Paola soils are hyperthermic and Welaka have Bir horizons. Cainhoy soils have an E' horizon underlain by Bh horizon. Centenary soils have Bh horizon in subsoil. Lakehurst soils occur in mesic temperature regimes. Rimini soils have a thick sandy E horizon overlying a continuous spodic horizon.

GEOGRAPHIC SETTING: The Kureb soils are gently sloping to moderately steep and are on broad surfaces of the lower Coastal Plains. Gradients are 3 to 10 percent and may range to 20 percent on side slopes along streams and edges of bays. The regolith is marine, aeolian or fluvial sands. Near the type location mean annual precipitation is about 50 inches and mean annual temperature is about 63 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Alaga, Kershaw, Lakeland, and Rimini series plus the Baymeade soils. Baymeade soils have sandy loam Bt horizons.

DRAINAGE AND PERMEABILITY: Excessively drained; Slow runoff. Rapid permeability. Depth to seasonal high water table is more than 6 feet during most of the year.

USE AND VEGETATION: Mainly wooded. Native vegetation is turkey oak, bluejack and a few live oak with scattered longleaf pine. The understory consists mainly of huckleberry and pineland threeawn.

DISTRIBUTION AND EXTENT: Lower Coastal Plains of North Carolina and possibly Georgia and South Carolina. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: New Hanover County, North Carolina; 1974.

REMARKS: The Kureb soils were formerly included in the Lakewood series. Diagnostic horizons and features recognized in this pedon are:

Ochric epipeon - the zone from the surface to a depth of 26 inches (A and E horizons)

MLRA: 153A SIR: NC0063

SIR/OSD REPORT

SOI-5 Soil Name Slope Airtemp FrFr/Seas Precip Elevation
NC0063 KUREB 0- 20 60- 70 200-290 46- 57 20- 90

SOI-5 FloodL FloodH Watertable Kind Months Bedrock Hardness NC0063 NONE 6.0-6.0 - 60-60

SOI-5 Depth Texture 3-Inch No-10 Clay% -CEC- NC0063 0-80 S COS FS 0- 0 100-100 0- 3 0- 5

SOI-5 Depth -pH- O.M. Salin Permeab Shnk-Swll
NC0063 0-80 3.5- 7.3 0.-2. 0- 0 6.0- 20 LOW

National Cooperative Soil Survey
U.S.A.

LOCATION BAYMEADE NC

Established Series
Rev. REH:ENH
1/87

BAYMEADE SERIES

The Baymeade series consists of deep, well drained soils with moderately rapid permeability. They formed in loamy and sandy marine sediments of the lower Coastal Plain. Slopes range from 0 to 12 percent. Mean annual temperature is 63 degrees F., and mean annual precipitation is 54 inches.

TAXONOMIC CLASS: Loamy, siliceous, thermic Arenic Hapludults

TYPICAL PEDON: Baymeade sand--on a 3 percent slope under mixed hardwood and pine. (Colors are for moist soil unless otherwise stated.)

A--0 to 3 inches; dark gray (10YR 4/1) fine sand; weak granular structure; loose; many fine and medium roots; many uncoated sand grains; medium acid; abrupt smooth boundary. (2 to 10 inches thick)

E--3 to 12 inches; light gray (10YR 7/2) fine sand; single grained; loose; many fine and medium roots; slightly acid; gradual wavy boundary. (0 to 15 inches thick)

E/Bh--12 to 36 inches; very pale brown (10YR 7/4) fine sand; single grained; loose; common irregular bodies of friable organic coated sand that are dark brown (7.5YR 3/2) and brown (7.5YR 4/4) (Bh) make up about 12 percent of this horizon; many fine and medium roots; medium acid; abrupt smooth boundary. (0 to 26 inches thick)

Bt--36 to 49 inches; strong brown (7.5YR 5/6) fine sandy loam; weak coarse subangular blocky structure that parts into weak fine granular structure; very friable; many fine and medium roots; medium acid; gradual wavy boundary. (5 to 40 inches thick)

BC--49 to 58 inches; strong brown (7.5YR 5/6) loamy fine sand; weak fine granular structure; very friable; few fine roots; medium acid; gradual wavy boundary. (0 to 17 inches thick)

C1--58 to 75 inches; mottled white (10YR 8/1) and very pale brown (10YR 7/4) fine sand; single grained; loose; medium acid; gradual wavy boundary.

C2--75 to 78 inches; very pale brown (10YR 8/3) fine sand and loamy fine sand; single grained; loose; medium acid.

TYPE LOCATION: New Hanover County, North Carolina; Wilmington, 0.5 mile south of Dawson and Sixteenth Streets on west side of Sixteenth Street road bank.

RANGE IN CHARACTERISTICS: Solum thickness is 35 to more than 60 inches. Reaction ranges from very strongly acid to slightly acid, unless limed. Some pedons have extremely acid A and E horizons.

The A or Ap horizon has hue of 10YR to 2.5Y value of 4 to 6, and chroma of 1 or 2 or is neutral with value of 4 to 6 with common clean grains that are white or light gray. Texture of the A horizon is sand, fine sand, loamy sand, or loamy fine sand.

The E horizon has hue of 10YR or 2.5Y, value of 4 to 8, and chroma of 1 to 6 or is neutral with value of 6 to 8. Texture is sand, fine sand, loamy sand, or loamy fine sand. The Bh portion of E/Bh horizon or Bh horizon, where present, is granular to massive with hue of 5YR to 10YR, value of 3 to 7, and chroma of 2 to 8.

The E' horizon, where present has hues of 7.5YR to 2.5Y, values of 4 to 8, and chroma of 2 to 6 or it is neutral with values of 6 to 8. It is sand, fine sand, loamy sand or loamy fine sand.

The Bt horizon has hue of 7.5YR to 2.5Y, value of 5 to 7, and chroma of 4 to 8. Mottles are in shades of yellow, brown, or gray at depths below 25 inches in some pedons. A gray matrix may be present in the lower Bt horizons of some pedons. Texture is commonly sandy loam or fine sandy loam but some pedons are sandy clay loam. The lower Bt horizon may occur as lamella of sandy loam.

The BC horizon has hue of 7.5YR to 2.5Y, value of 5 to 7, and chroma of 2 to 8. Mottles are in shades of yellow, brown, or gray in some pedons. Texture is loamy sand, loamy fine sand, sandy loam, fine sandy loam or in some pedons sandy clay loam.

The C horizon has hue of 7.5YR to 2.5Y, value of 5 to 8, and chroma of 1 to 8 or is mottled in shades of these colors. Texture is sand or fine sand or stratified sandy, loamy, or clayey material. Some pedons have thin discontinuous Bh bodies in the C horizon.

COMPETING SERIES: Ailey, Blaney, Chipola, Chisolm, Coosaw, Garçon, Gomery, Kenansville, Remlik, Tenaha, Tomahawk, Uchee, and Valhalla in the same family. Closely related soils are the Alaga, Eustis, Kureb, Onslow, Seagate, Wagram, and Wakulla series. All of these soils except Kureb lack irregular intermittent Bh bodies in the E/Bh horizon. Kureb soils lack argillic horizons. Onslow soils lack an arenic epipedon and contain gray mottles indicative of wetness in the Bt horizon. Seagate and Valhalla soils have continuous Bh horizons. Seagate soils have poorer drainage.

GEOGRAPHIC SETTING: Baymeade soils occur on broad, gently sloping surfaces of the lower Coastal Plain, generally above 20 feet. Slopes range from 1 to 12 percent. They formed in (stratified) interbedded sandy and loamy Coastal Plain sediments. The mean annual precipitation ranges from 47 to 60 inches and mean annual temperature ranges from 53 to 74 degrees F.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Kureb and the Blanton, Foreston, Goldsboro, Lakeland, Leon, Norfolk and Rimini series. Blanton soils have a Grossarenic epipedon. Foreston, Goldsboro and Norfolk lack an arenic epipedon. Lakeland soils lack light gray E horizons and an argillic horizon. Leon and Rimini soils have continuous Bh horizons, and the Leon soils have poorer drainage.

DRAINAGE AND PERMEABILITY: Well drained; slow runoff; moderately rapid permeability. Measured watertable levels at two sites show that the water table is 45 to 60 inches below the surface in December to April and other wet periods.

USE AND VEGETATION: Most of these soils are in forest of mixed hardwood and pine. Native vegetation is turkey oak, long leaf pine, dwarfed huckleberry, small myrtle, wire grass, and astor. Large areas are in residential and urban uses in New Hanover County.

DISTRIBUTION AND EXTENT: Lower Coastal Plains of North Carolina and possibly South Carolina. The series is extensive.

MLRA OFFICE RESPONSIBLE: Raleigh, North Carolina

SERIES ESTABLISHED: New Hanover County, North Carolina; 1973.

Remarks: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - the zone from the surface to a depth of 36 inches (the Ap and E horizons)

Arenic feature - the zone of sandy sediments from 0 to 36 inches (the A, E, E/Bh horizons)

Argillic horizon - the zone from a depth of 36 to 58 inches (the Bt and BC horizons)

National Cooperative Soil Survey
U. S. A.

LOCATION MUCKALEE GA+AL FL NC VA

Established Series
Rev. JAP:RLW
9/87

MUCKALEE SERIES

The Muckalee series consists of poorly drained moderately permeable soils formed in loamy and sandy alluvium. These soils are on flood plains of streams in the Coastal Plain. Slopes range from 0 to 2 percent. Near the type location, mean annual temperature is about 68 degrees F. and mean annual precipitation is about 48 inches.

TAXONOMIC CLASS: Coarse-loamy, siliceous, nonacid, thermic Typic Fluvaquents

TYPICAL PEDON: Muckalee loam--on a level slope in forest. (Colors are for moist soil unless otherwise stated.)

A--0 to 6 inches; dark gray (10YR 4/1) loam; weak, medium, granular structure; friable; common, thin (0.1 to 0.2 inch thick) strata of light gray (10YR 7/1) sand and yellowish red (5YR 4/8)
clay loam; many fine and medium roots; strongly acid; clear wavy boundary. (3 to 12 inches thick)

C1g--6 to 28 inches; gray (5Y 5/1) loamy sand; single grained; friable; common, thin (0.1 to 0.3 inch thick) strata of light gray (5Y 7/1) sand and yellowish brown (10YR 5/6) sandy clay loam; common fine roots; medium acid; clear smooth boundary. (10 to 24 inches thick)

C2g--28 to 43 inches; dark gray (5YR 4/1) sandy loam; massive; friable; common, thin (0.2 to 0.3 inch thick) strata of grayish brown (10YR 5/2) and pale brown (10YR 6/3) loamy sand and light gray (10YR 7/1) sand; few fine roots; slightly acid; clear smooth boundary. (10 to 20 inches thick)

C3g--43 to 53 inches; thinly stratified dark gray (10YR 4/1), very dark gray (10YR 3/1) and light gray (10YR 7/1) loamy sand, sand and sandy clay loam; massive; very friable; few fine roots; slightly acid; clear, smooth boundary. (0 to 15 inches thick)

C4g--53 to 64 inches; gray (10YR 5/1) sandy loam; massive; friable; common, thick (0.3 to 2.0 inch thick) strata of light gray (2.5Y 7/2) sand and few strata of yellowish brown (10YR 5/6) clay; few fine roots; slightly acid.

TYPE LOCATION: Lee County, Georgia; 3.9 miles east of Smithville on Georgia Highway 118 to Muckaloochee Creek, 4.0 miles southeast along creek to a county road, 30 yards east of creek, 25 yards south of road.

RANGE IN CHARACTERISTICS: The A horizon is strongly acid through neutral and the C horizon is medium acid through moderately alkaline.

The A horizon has hue of 10YR, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 or 2. Value of 3 is allowed when A horizon is less than 6 inches thick. Texture is loamy sand, sandy loam, loamy fine sand, fine sandy loam, or loam. Few or common thin strata of contrasting textures are allowed and range from 0.1 to 1.0 inch in thickness.

The C horizon has hue of 10YR to 5Y, value of 4 to 7, and chroma of 1 or 2 or it is neutral with value of 5, 6, or 7. Some pedons have lower C horizons that are greenish gray (5GY 6/1, 5/1; 5G 6/1, 5/1). Few to many strata or mottles have hue of 10YR, 2.5Y, or 5Y, value of 3 to 5, and chroma of 1 to 8. The C horizon is loamy sand or sandy loam. There are strata of sand, sandy clay loam, or clay loam 0.1 to 3.0 inches thick. The 10 to 40 inch control section averages about 10 to 18 percent clay.

COMPETING SERIES: There are presently no other series in this family. The Angelina, Bibb, Briscot, Enoree, Herod, Kinston, Osier, and Wehadkee series are in similar families. Angelina, Herod, Kinston, and Wehadkee soils have more than 18 percent clay between 10 to 40 inches. In addition, Angelina and Kinston soils are in acid families. Wehadkee soils have mixed mineralogy. Bibb soils are in an acid family. Briscot and Enoree soils have mixed mineralogy. Osier soils are sandy.

GEOGRAPHIC SETTING: Muckalee soils occur on the flood plains of streams in the Coastal Plains. The soil formed in loamy and sandy alluvium. Stream channels are generally shallow and meandering. The soils flood frequently for brief periods. Slopes are less than 2 percent. The mean annual temperature is about 65 to 70 degrees F., and the mean annual precipitation is 45 to 55 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Herod series and the Grady, Meggett, Osier and Riverview series. Grady soils are clayey and in depressions or around the head of or along narrow drainageways. Meggett soils are in a fine family. Osier soils are sandy throughout. Riverview soils are well drained.

DRAINAGE AND PERMEABILITY: Poorly drained; very slow runoff; moderate permeability.

USE AND VEGETATION: Dominantly native woodland of bay, sweetgum, blackgum, water tupelo, red maple, water oak, loblolly pine, and willow. A few areas have been cleared, drained and used for pasture.

DISTRIBUTION AND EXTENT: Coastal plain of Georgia, Alabama, North Carolina, and South Carolina. The series is of moderate extent.

MLRA OFFICE RESPONSIBLE: Auburn, Alabama

SERIES ESTABLISHED: Lee County, Georgia; 1974. REMARKS: The Muckalee series was formerly included with the Bibb series. Recent laboratory data show these non-acid soils to occur over the Ocala limestone formation. It is thought this soil will occur over other limestone formations that occur near the surface.

REMARKS: Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - the zone from the surface to a depth of 6 inches (the A horizon).

National Cooperative Soil Survey
U. S. A.

LOCATION MARVYN AL+NC

Established Series
Rev. RBM-PGM
03/97

MARVYN SERIES

The Marvyn series consists of deep, well drained, moderately permeable soils that formed in loamy marine sediments on Coastal Plain uplands. Slope ranges from 0 to 15 percent.

TAXONOMIC CLASS: Fine-loamy, kaolinitic, thermic Typic Kanhapludults

TYPICAL PEDON: Marvyn loamy sand, on a smooth convex 2 percent slope, in a cultivated field. (Colors are for moist soil.)

Ap--0 to 7 inches; dark grayish brown (10YR 4/2) loamy sand; weak fine granular structure; very friable; many fine roots; 5 percent rounded gravel less than one inch in diameter; medium acid; abrupt smooth boundary. (5 to 12 inches thick)

Bt1--7 to 15 inches; yellowish brown (10YR 5/6) sandy loam; weak medium subangular blocky structure; very friable; common fine roots; sand grains bridged and coated with clay; strongly acid; clear smooth boundary.

Bt2--15 to 30 inches; strong brown (7.5YR 5/6) sandy clay loam; weak medium subangular blocky structure; friable; few fine roots; thin patchy clay films on faces of peds; strongly acid; clear smooth boundary.

Bt3--30 to 44 inches; brownish yellow (10YR 6/6) sandy clay; many medium prominent red (2.5YR 4/8) mottles; moderate medium subangular blocky structure; friable; few fine roots; thin patchy clay films on faces of peds; very strongly acid; clear smooth boundary. (Combined thickness of the Bt horizon is 25 to 50 inches)

BC--44 to 53 inches; yellowish red (5YR 5/8) sandy clay; common medium prominent brownish yellow (10YR 6/6) mottles in discontinuous bands; weak medium subangular blocky structure; friable; few fine roots; thin patchy clay films on faces of peds; few fine flakes of mica; very strongly acid; abrupt smooth boundary. (4 to 12 inches thick)

C--53 to 60 inches; mottled red (2.5YR 4/8, 5/8), light olive brown (2.5Y 5/6) and light gray (10YR 7/2); average texture is sandy clay loam; red and brown parts are sandy loam and sandy clay loam, gray parts are clay and sandy clay; colors and textures are in bands about one centimeter thick; massive, grading to weak platy; friable; few to common flakes of mica; very strongly acid; abrupt smooth boundary. (5 to 15 inches thick)

2C--60 to 72 inches; reddish yellow (7.5YR 6/8, 7/8) sandy loam; common medium prominent red (2.5YR 4/8) mottles; massive; friable; few pockets of white clay; very friable; common to many flakes of mica; very strongly acid.

TYPE LOCATION: Lee County, Alabama; 2.5 miles west of Marvyn on U.S. Highway 80; 375 feet southwest of the northeast corner of the SW1/4SE1/4 sec. 23, T. 17 N., R. 26 E.

RANGE IN CHARACTERISTICS: Solum thickness ranges from 40 to 60 inches. The soil is medium acid to very strongly acid throughout, except where lime has been added. There are few to common flakes of mica in the lower part of the Bt horizon and few to many in the BC and C horizons.

The Ap or A horizon has hue of 10YR, value of 3 to 5, and chroma of 2 or 3. It is loamy sand, loamy fine sand, sandy loam, or fine sandy loam.

The E horizon, present in some pedons, has hue of 10YR, value of 5 or 6, and chroma 3 or 4. It is 3 to 8 inches thick and is loamy sand, loamy fine sand, sandy loam, or fine sandy loam.

The BA or BE horizon, present in some pedons, has hue of 7.5YR or 10YR, value of 4 or 5, and chroma of 4 to 8. Texture is sandy loam or sandy clay loam.

The Bt horizon has hue of 7.5YR or 10YR, value of 5 or 6, and chroma of 4 to 8. It is distinctly or prominently mottled with yellow, brown, or red in the lower part. Texture is dominantly sandy loam or sandy clay loam in the upper part, but ranges to sandy clay in the lower part of the Bt horizon. The upper 20 inches of the kandic horizon averages less than 20 percent silt.

The BC horizon has hue 10YR to 5YR, value of 5 or 6, and chroma of 4 to 8 ; or it has no dominant matrix color and is mottled in shades of yellow, brown, red, and gray. Texture is mainly sandy clay or sandy clay loam but ranges to sandy loam and is often stratified.

The C horizon is generally thinly stratified and has no dominant matrix color. Strata range in color from red to gray and in texture from sandy loam to clay. The coarser textured strata are generally reddish or brownish in color, while the finer textured strata are generally grayish in color.

The 2C horizon, where present, has yellow, red, brown, or white colors. It is sandy loam or loamy sand.

COMPETING SERIES: These include the Cowarts and Springhill series in the same family and the Apison, Cahaba, Durham, Emporia, Euharlee, Granville, Hartsells, Kempsville, Linker, Nauvoo, Pirum, Smithdale, Spadra, Stringtown, Suffolk, and Vaucluse series in similar families. The Cowarts series have a solum thickness of less than 40 inches. The Cahaba, Smithdale, and Springhill series have hue of 5YR or redder throughout the Bt horizon. The Apison, Hartsells, Linker, Nauvoo, and Pirum soils are underlain by bedrock at a depth of less than 60 inches. Durham and Granville soils have saprolite within 40 to 60 inches of the surface. Emporia soils have mottles with chroma of

2 or less between a depth of 30 and 50 inches. Euharlee soils have more than 30 percent silt in the control section. Kempsville soils have subsoil layers in which 20 to 60 percent of the matrix is brittle. Spadra soils have Bt horizons with hue redder than 7.5YR or have color value less than 5. Suffolk soils have moderately rapidly permeable to rapidly permeable C horizons. Stringtown soils contain fragments or strata of shale and sandstone in the BC and C horizons. Vaucluse soils have a dense, brittle horizon within 36 inches of the surface.

GEOGRAPHIC SETTING: Marvyn soils are on nearly level to strongly sloping topography of the Coastal Plain uplands. Dominant slope gradients are 2 to 5 percent but slopes range from 0 to 15 percent. The soil formed in marine sediments. Mean annual temperature near the type location is 65 degrees F, and mean annual precipitation is 54 inches.

GEOGRAPHICALLY ASSOCIATED SOILS: These are the competing Cowarts series and the Marlboro, Rumford, Uchee, and Wagram series on similar positions as the Marvyn soils and the Wickham series on adjacent stream terraces. Marlboro soils have a clayey particle-size control section. Rumford soils have a coarse-loamy particle-size control section. Uchee and Wagram soils have a sandy epipedon 20 to 40 inches thick. Wickham soils have mixed mineralogy.

DRAINAGE AND PERMEABILITY: Well drained; slow to medium runoff; permeability is moderate in the subsoil and moderate to moderately slow in the substratum.

USE AND VEGETATION: Mostly cleared and used for the production of row crops, mainly cotton. Small areas are in pasture or in forests of mixed hardwoods and pines.

DISTRIBUTION AND EXTENT: Coastal Plain of Alabama, Georgia, North Carolina and South Carolina. It is moderately extensive.

MLRA OFFICE RESPONSIBLE: Auburn, Alabama

SERIES ESTABLISHED: Lee County, Alabama; 1979.

REMARKS: This revision (6/89) changes the classification from Typic Hapludults to Typic Kanhapludults in recognition of the low activity clay of the kandic horizon.

Diagnostic horizons and features recognized in this pedon are:

Ochric epipedon - the zone from the surface of the soil to a depth of approximately 7 inches (Ap horizon).

Kandic horizon - the zone from approximately 7 to 53 inches (Bt1, Bt2, Bt3, and BC horizons).

ADDITIONAL DATA: Laboratory data for typifying pedon from Auburn University, Sample Number S73AL-041-3-(1-7), and from the Alabama Highway Department S73AL-041-3-(1, 4, 7).

National Cooperative Soil Survey
U.S.A.

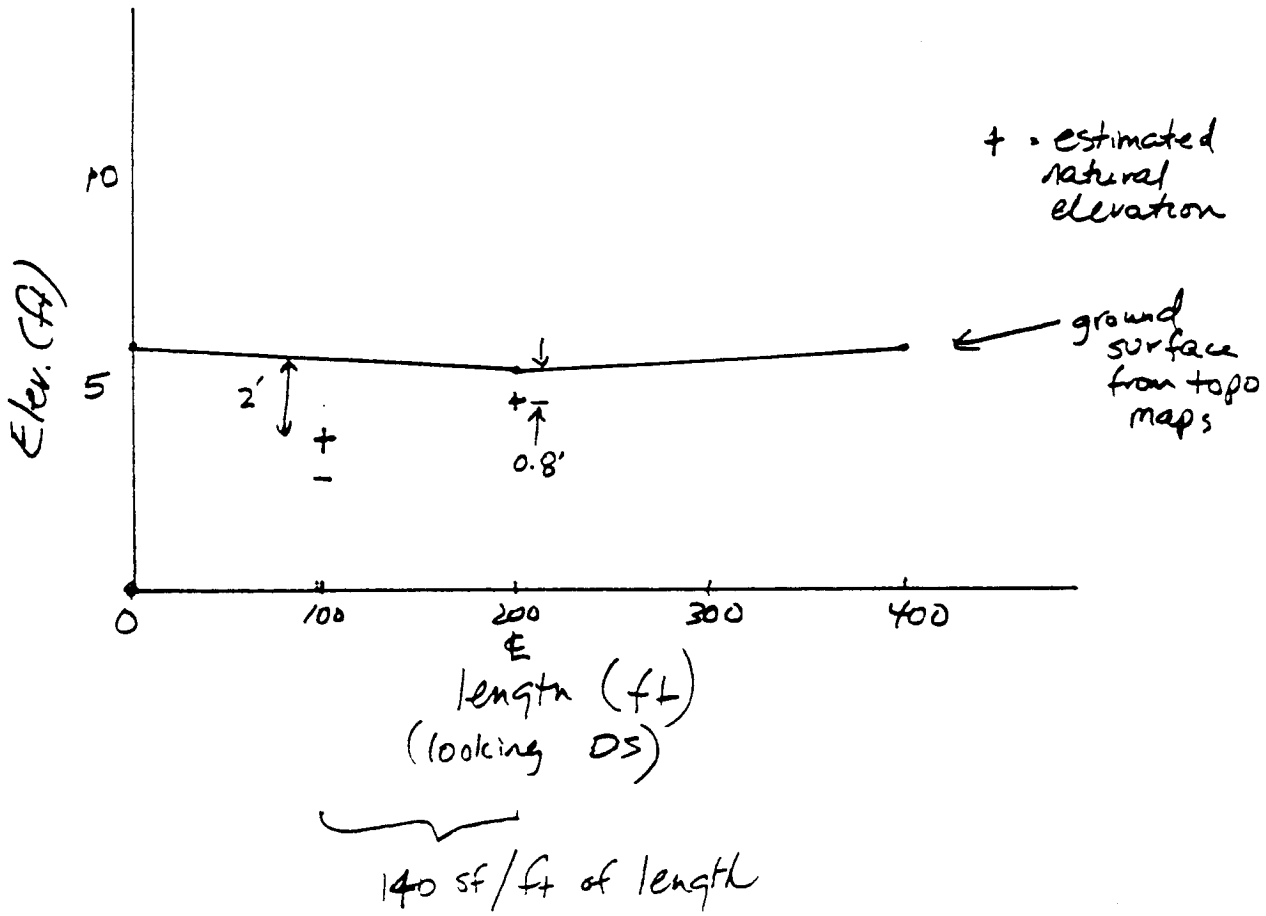
Attachment B: Sediment Depth Cross Sections

SUBJECT Site 14
At grade Crossing 2

BY LRG

SHEET NO. ____ OF ____ DATE ____

PROJECT NO. ____

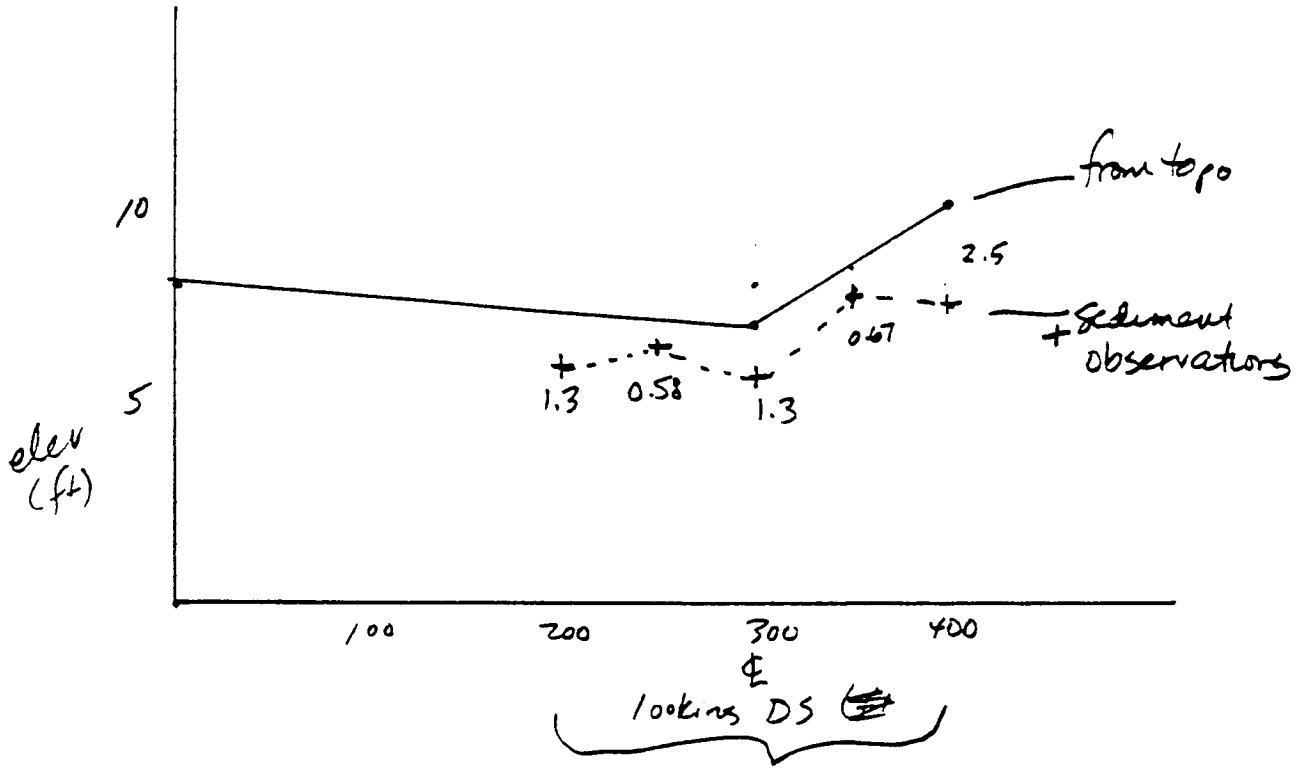


140 sf/ft of length

SUBJECT Site 15 At-grade Crossing 1 BY LRG

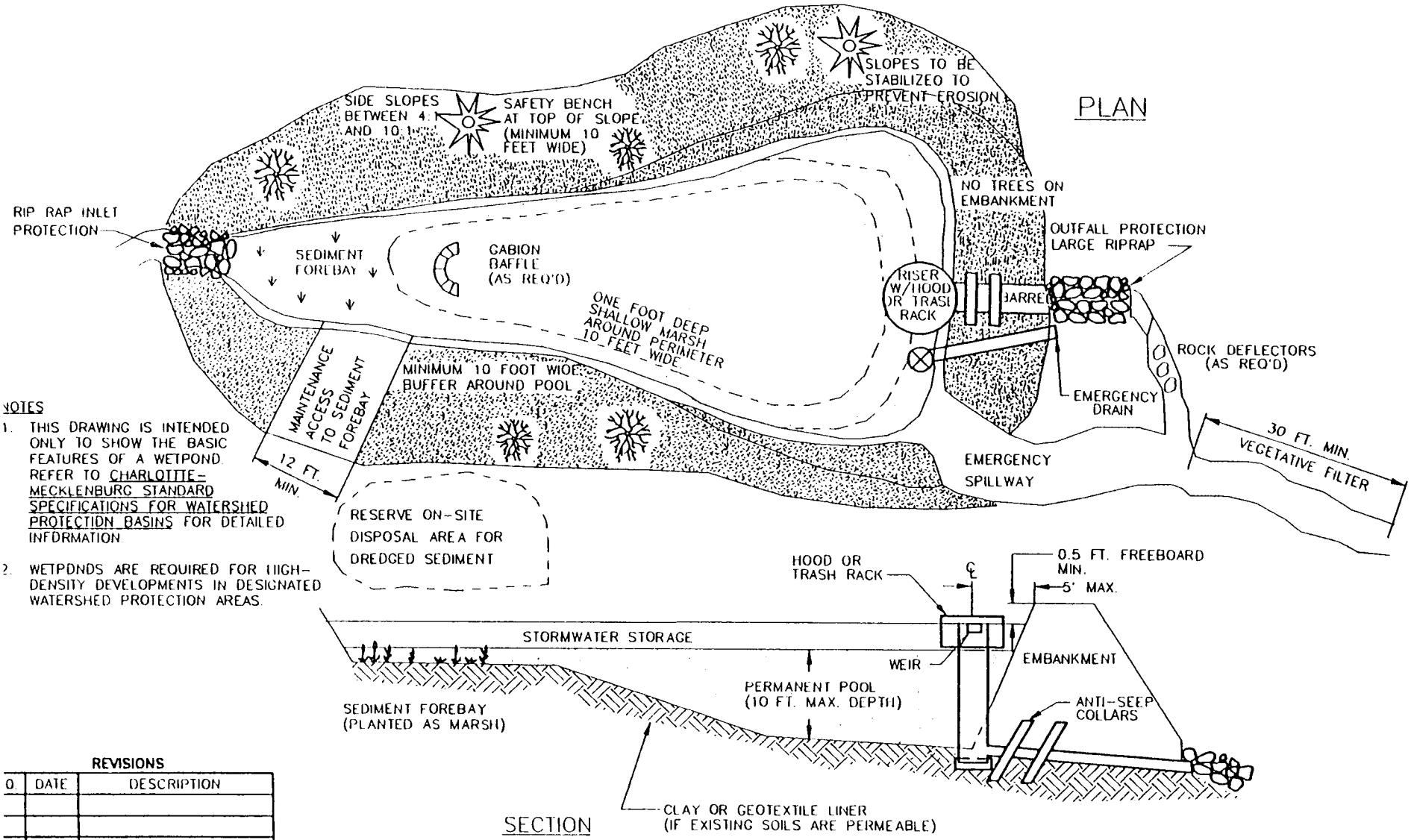
SHEET NO ____ of ____ DATE ____

PROJECT NO ____



254 sf/ft length

Attachment C: Typical Conceptual Designs



NOTES

1. THIS DRAWING IS INTENDED ONLY TO SHOW THE BASIC FEATURES OF A WETPOND REFER TO CHARLOTTE-MECKLENBURG STANDARD SPECIFICATIONS FOR WATERSHED PROTECTION BASINS FOR DETAILED INFORMATION.
2. WETPONDS ARE REQUIRED FOR HIGH-DENSITY DEVELOPMENTS IN DESIGNATED WATERSHED PROTECTION AREAS.

REVISIONS

NO.	DATE	DESCRIPTION

REFERENCE: CONTROLLING URBAN RUNOFF [1]

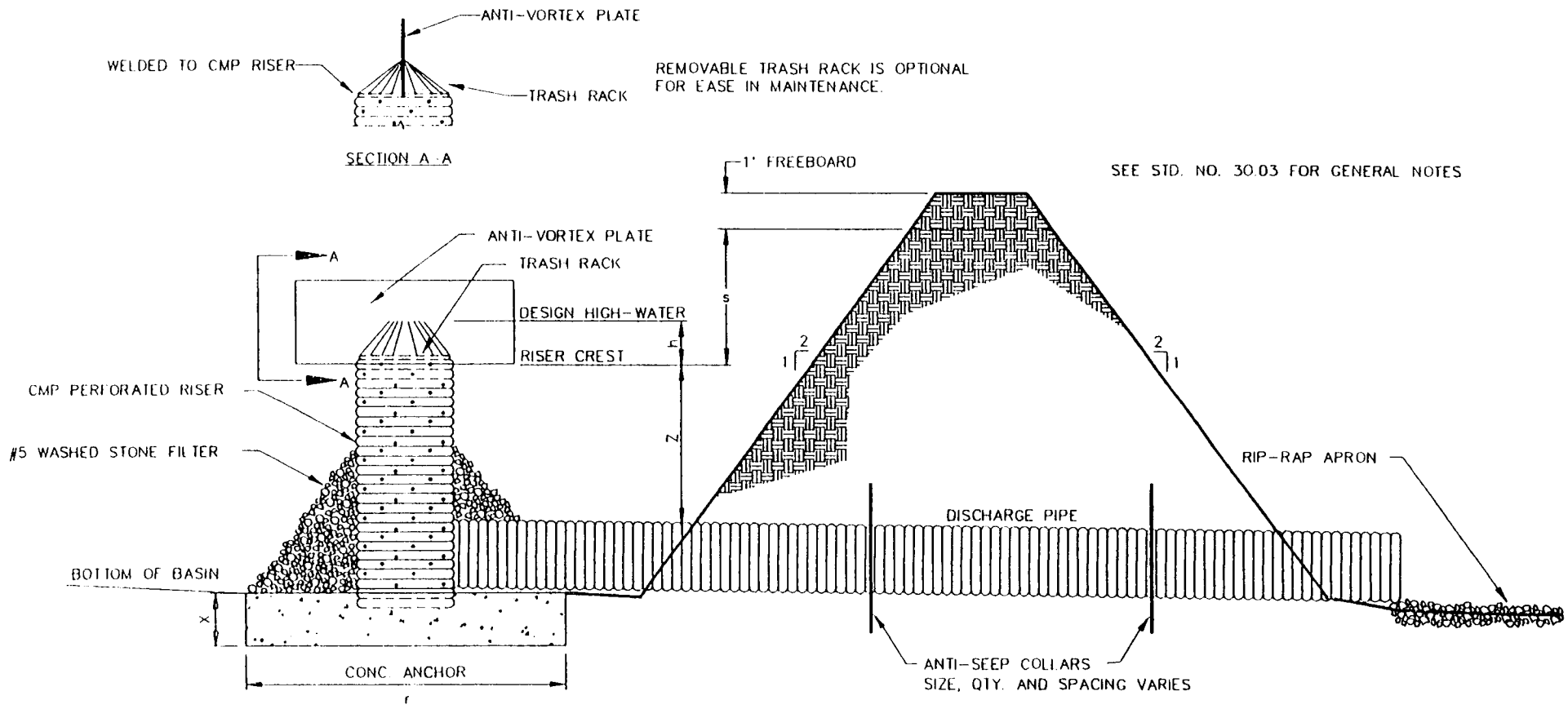
APPROVED DATE 7-24-95

CHARLOTTE – MECKLENBURG LAND DEVELOPMENT STANDARDS

BEST MANAGEMENT PRACTICES (WET POND)

Figure A-1

STD. NO.	REV.
20.36	



DATA BLOCK

ø RISER	ø BARREL	z	h	r	s	x

DATA BLOCK TO BE COMPLETED BY DESIGNER AND SUBMITTED WITH EROSION CONTROL PLANS.

REVISIONS

NO.	DATE	DESCRIPTION
1	10/95	ADDED "x" COLUMN TO DATA BLOCK

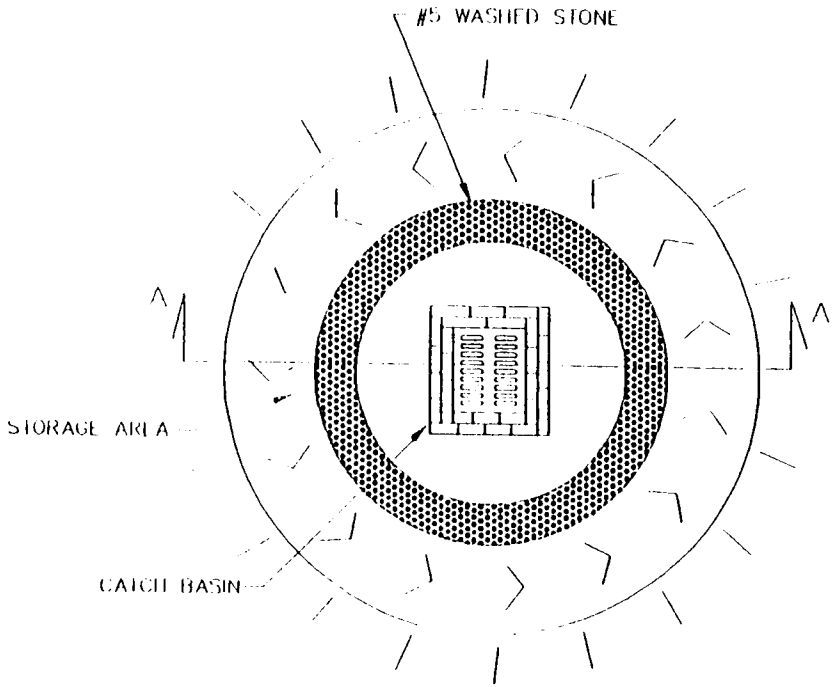
APPROVED DATE 10-19-95

CHARLOTTE – MECKLENBURG LAND DEVELOPMENT STANDARDS

RISER TYPE SEDIMENT BASIN

Figure A-2

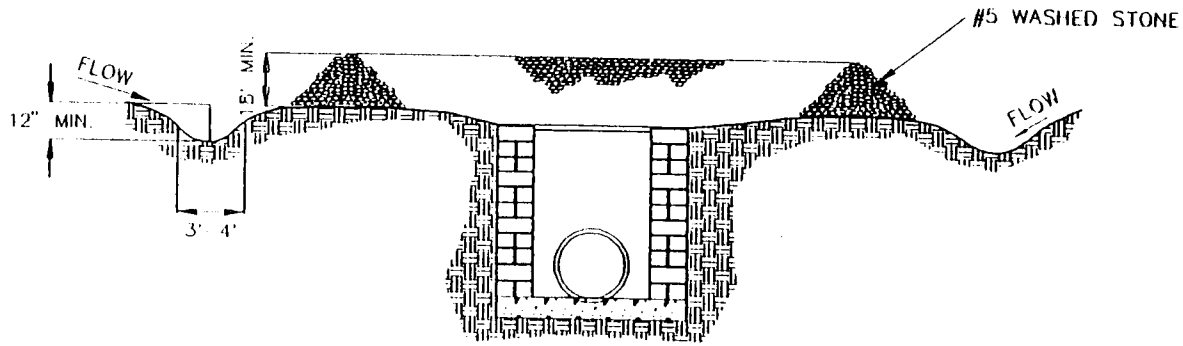
STD. NO. 30.0 REV.



PLAN VIEW

GENERAL NOTES:

1. SEDIMENT SHALL BE REMOVED AND TRAP RESTORED TO ITS ORIGINAL DIMENSIONS WHEN THE SEDIMENT HAS ACCUMULATED TO 1/2 THE DESIGN DEPTH OF THE TRAP.
2. REMOVED SEDIMENT SHALL BE DEPOSITED IN A SUITABLE AREA AND IN SUCH A MANNER THAT IT WILL NOT ERODE.
3. THE STRUCTURE SHALL BE INSPECTED BY THE FINANCIALLY RESPONSIBLE PARTY OR HIS AGENT AFTER EACH STORM EVENT AND REPAIRS MADE AS NECESSARY.
4. CONSTRUCTION OPERATIONS SHALL BE CARRIED OUT IN SUCH A MANNER THAT EROSION AND WATER POLLUTION ARE MINIMIZED.
5. THE SEDIMENT TRAP SHALL BE REMOVED AND THE AREA STABILIZED WHEN THE DRAINAGE BASIN HAS BEEN PROPERLY STABILIZED.
6. ON LARGER DRAINAGE AREAS RIP RAP MAY BE REQUIRED UNDER THE WASHED STONE.



SECTION A-A

REVISIONS

NO	DATE	DESCRIPTION
1	10/95	REVISED NOTE #3

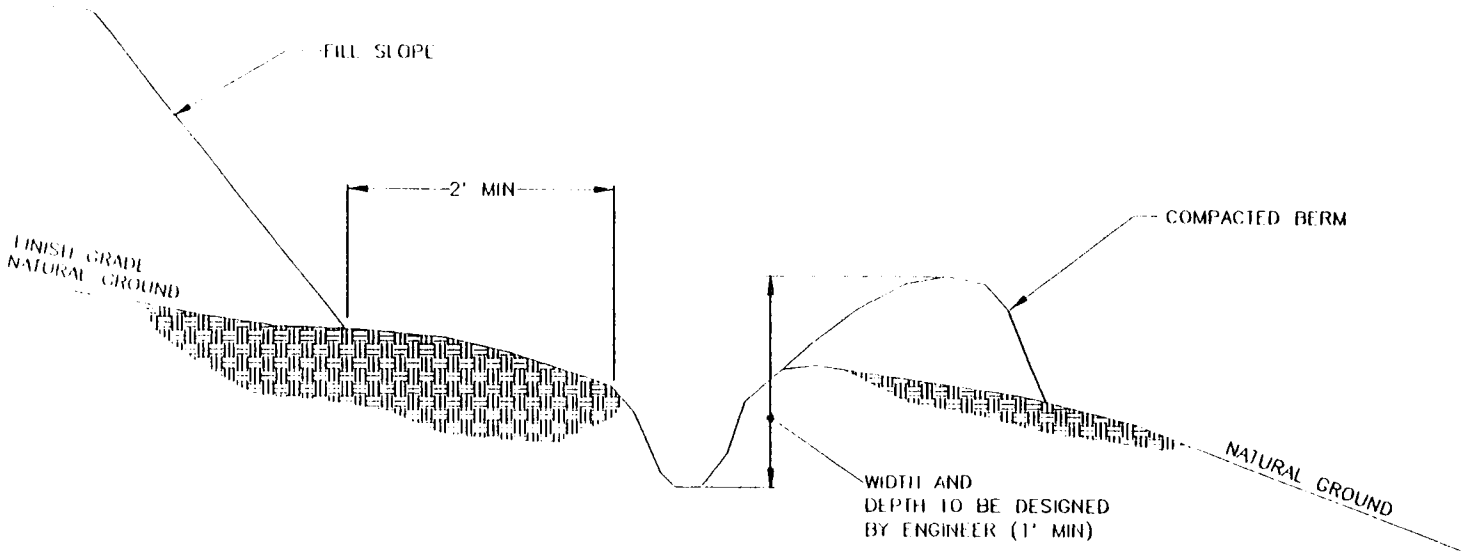
APPROVED DATE 10-19-95

CHARLOTTE – MECKLENBURG LAND DEVELOPMENT STANDARDS

STONE INLET SEDIMENT TRAP

Figure A-3

STD. NO.	REV.
30.08	



NOTE:

1. DITCH SHOULD HAVE LONGITUDINAL SLOP OF 1%.

REVISIONS

NO	DATE	DESCRIPTION
1	10/95	ADDED NOTE 1

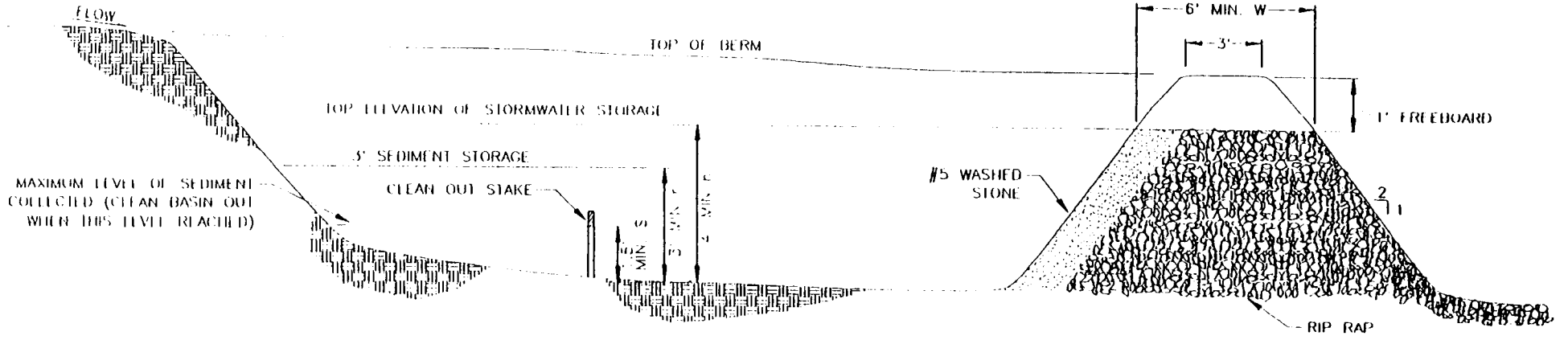
APPROVED DATE 10-19-95

CHARLOTTE – MECKLENBURG LAND DEVELOPMENT STANDARDS

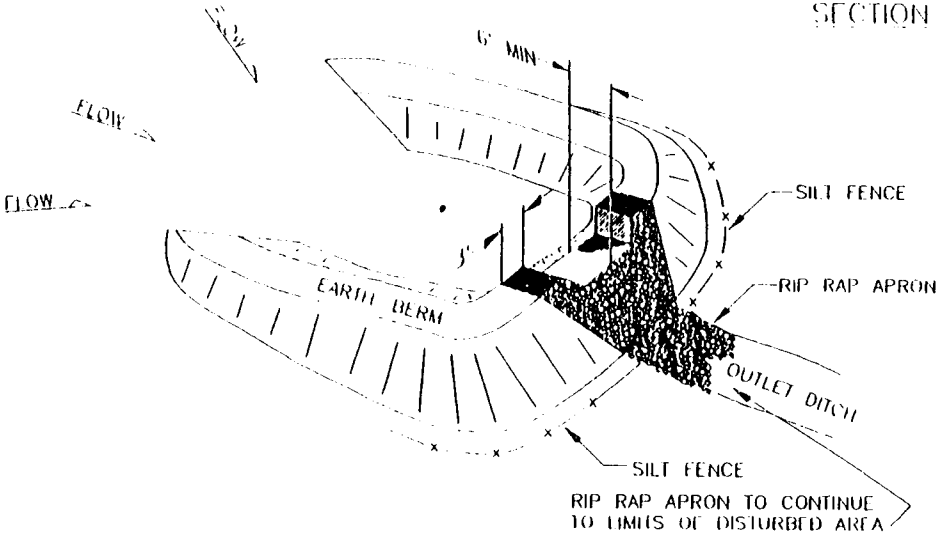
TEMPORARY SILT DITCH

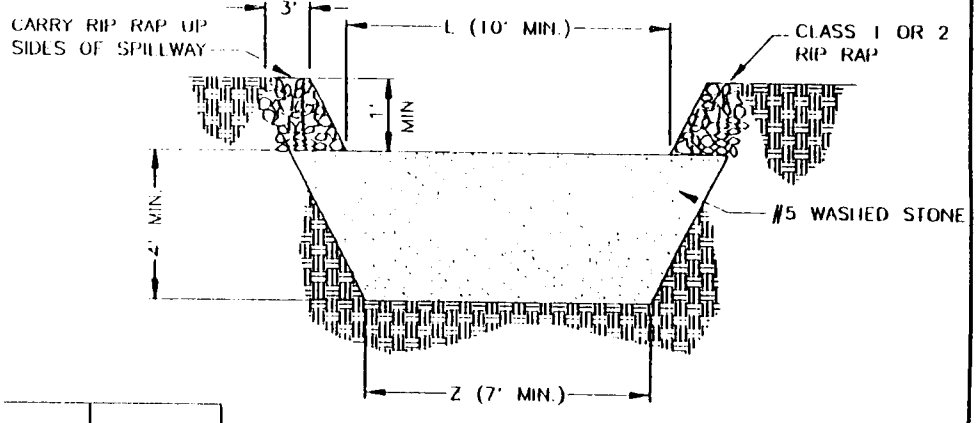
Figure A-4

STD. NO.	REV.
30[illegible]5	



SECTION THROUGH BASIN AND FILTER





ELEVATION OF BERM AND FILTER

DATA BLOCK

W	L	h	r	S	Z

DATA BLOCK TO BE COMPLETED BY DESIGNER AND SUBMITTED WITH EROSION CONTROL PLANS

REVISIONS

NO.	DATE	DESCRIPTION

APPROVED DATE 7-24-95

CHARLOTTE – MECKLENBURG LAND DEVELOPMENT STANDARDS

GRAVEL AND RIP RAP SEDIMENT BASIN

Figure A-5

STD. NO.	REV.
30.02	

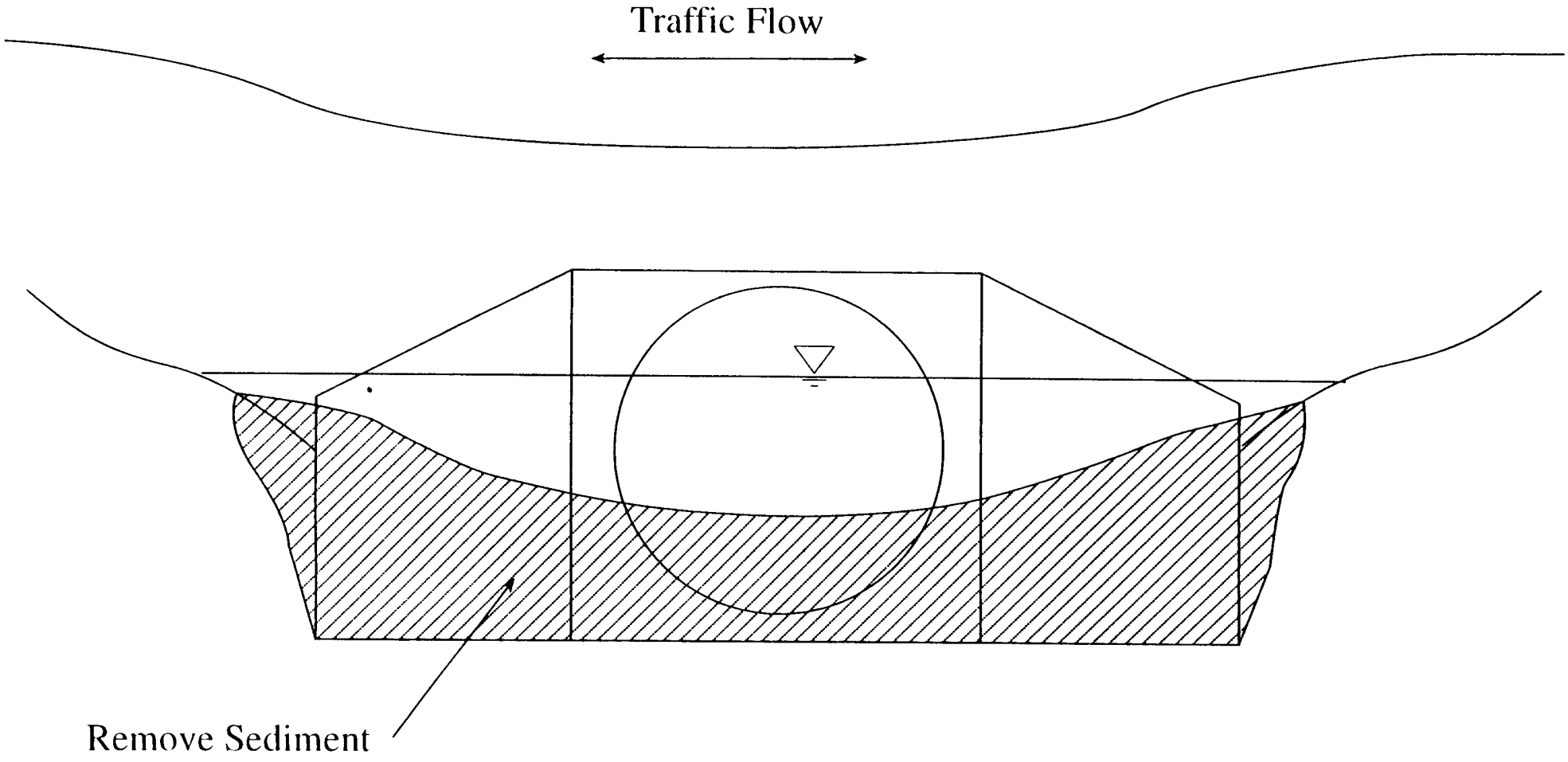
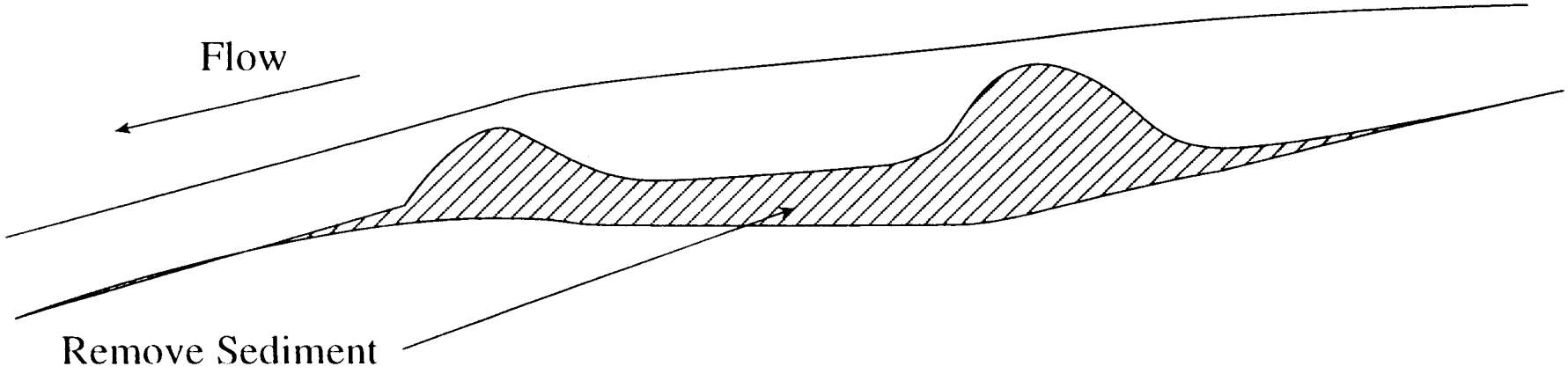


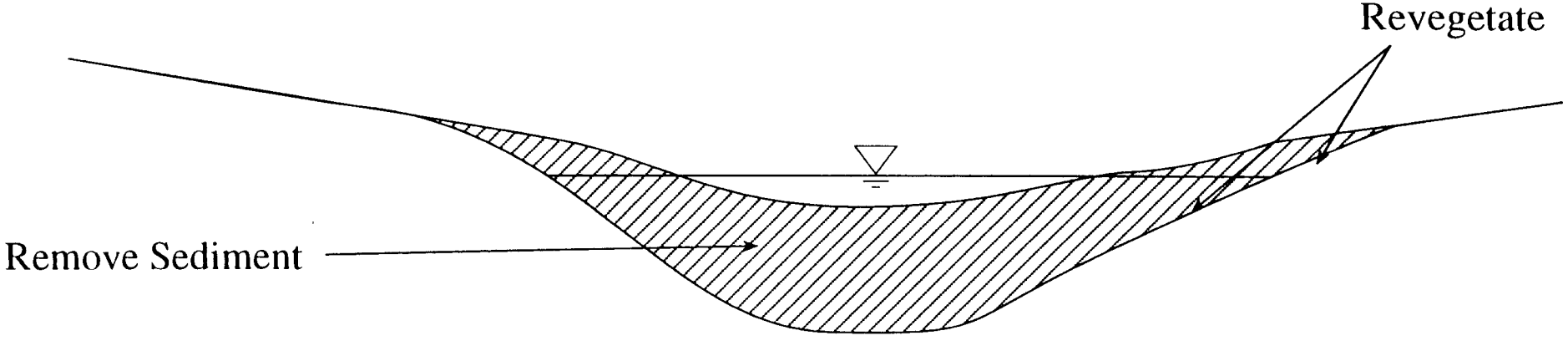
Figure A-6

Restoration of Culvert Cross-Section



Removal of At-Grade Crossings

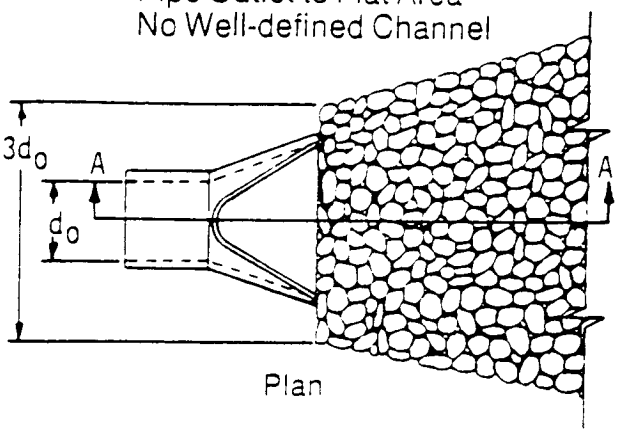
Figure A-7a

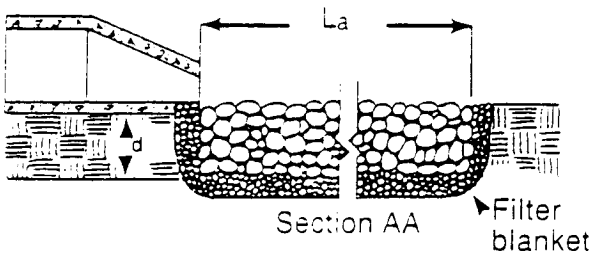


Restoration of Stream Cross-Section

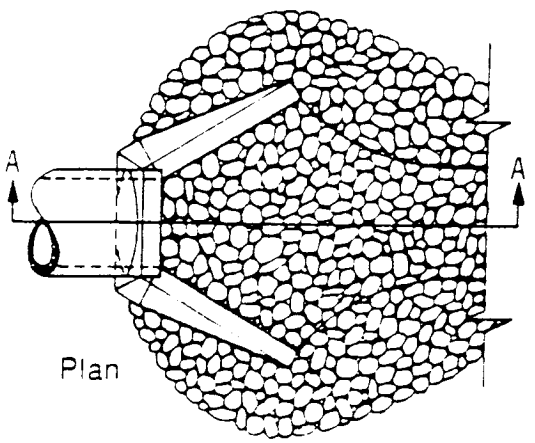
Figure A-7b

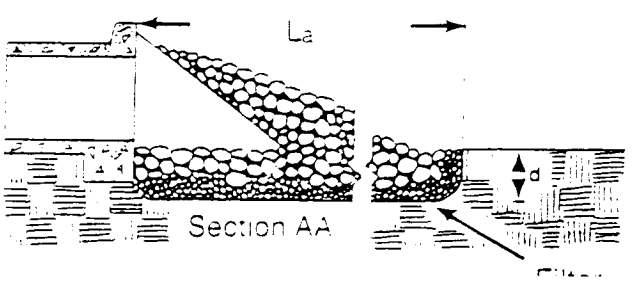
Pipe Outlet to Flat Area—
No Well-defined Channel





Pipe Outlet to Well-defined
Channel





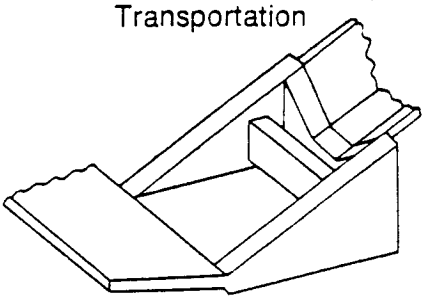
Notes

1. L_a is the length of the riprap apron.
2. d = 1.5 times the maximum stone diameter but not less than 6".
3. In a well-defined channel extend the apron up the channel banks to an elevation of 6" above the maximum tailwater depth or to the top of the bank, whichever is less.
4. A filter blanket or filter fabric should be installed between the riprap and soil foundation.

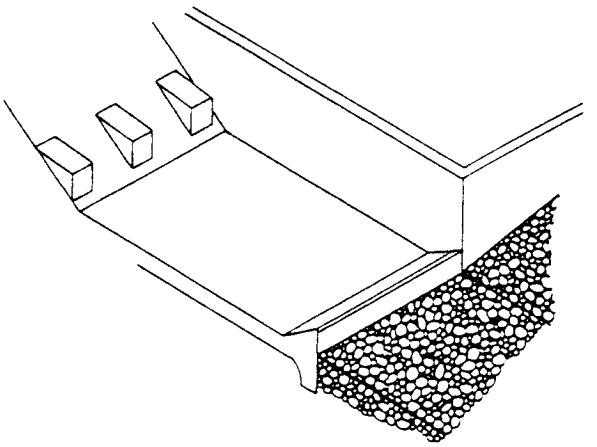
Figure A-8

Culvert Outlet Erosion Protection

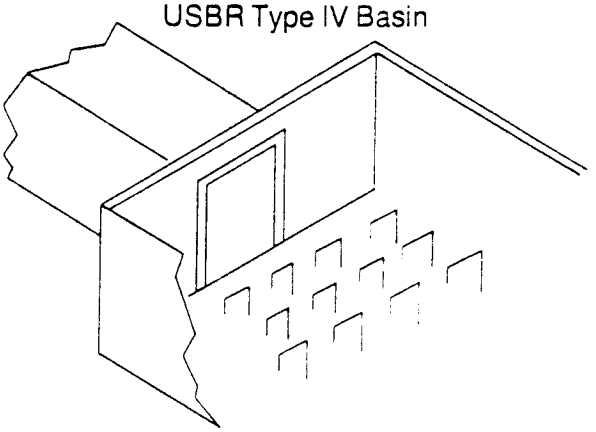
Virginia Department of Highways and Transportation



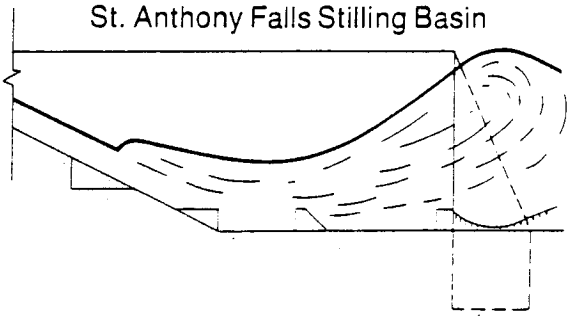
Colorado State University Rigid Boundary Basin



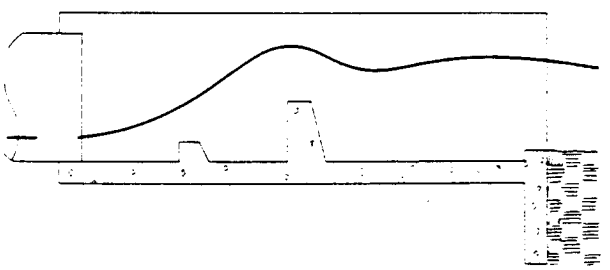
USBR Type IV Basin



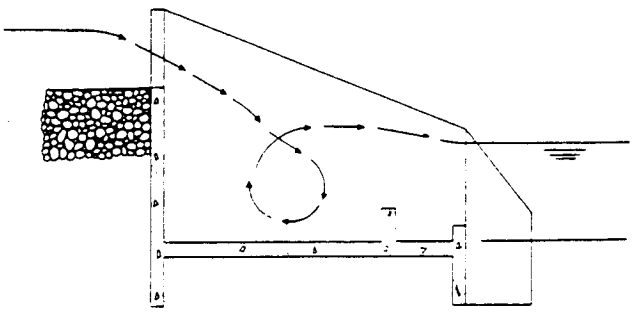
St. Anthony Falls Stilling Basin



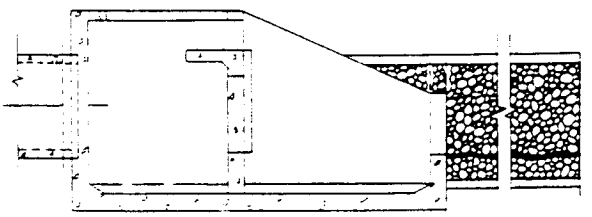
Contra Costa County, Calif.



Straight Drop Spillway Stilling Basin



USBR Type VI Baffle Wall Basin



T-fitting on CMP Outlet

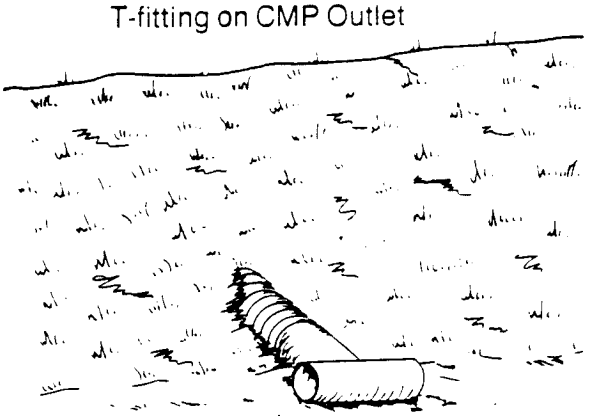


Figure 6.41a Alternative structures for energy dissipation at an outlet (modified from Goldman, Jackson, and Bursztynsky).

Figure A-9

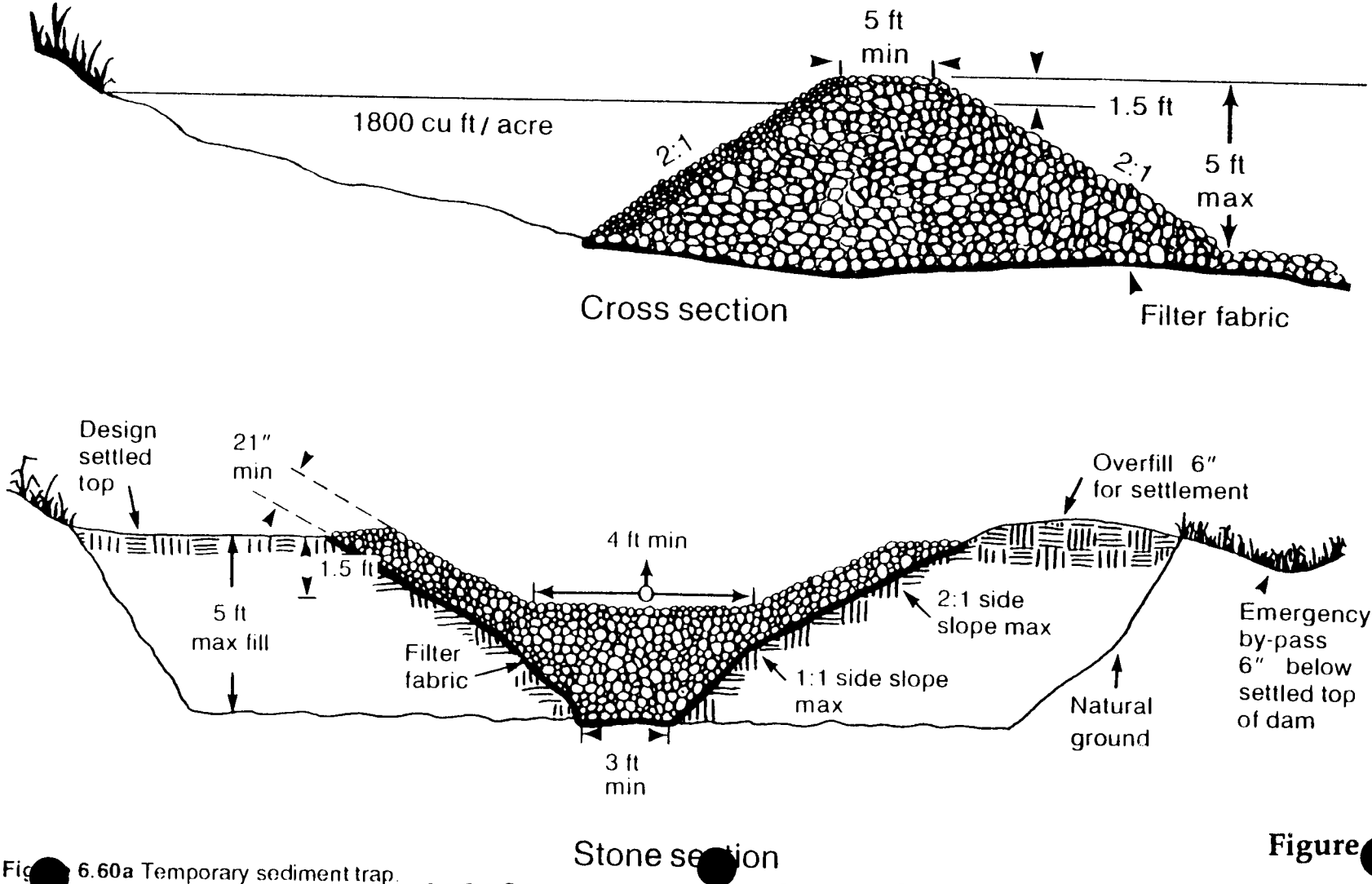
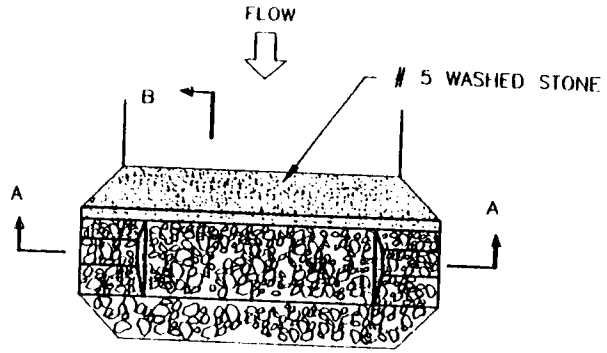


Figure 6.60a Temporary sediment trap

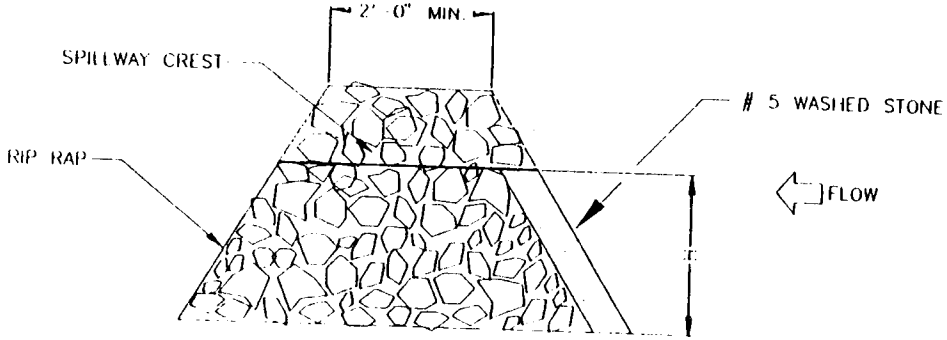
Figure 10

GENERAL NOTES.

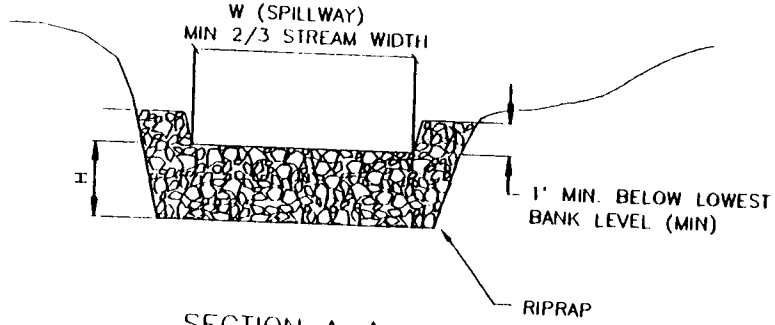
RIPRAP SIZE TO BE DESIGNED BY ENGINEER.



PLAN



SECTION B-B



SECTION A-A

REVISIONS

NO	DATE	DESCRIPTION

APPROVED DATE 7-24-95

CHARLOTTE – MECKLENBURG LAND DEVELOPMENT STANDARDS

TEMPORARY ROCK CHECK DAM

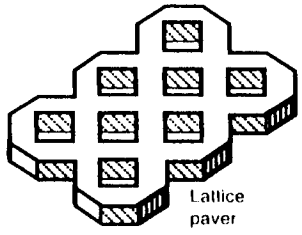
Figure A-11

STD. NO.	REV.
30.10	

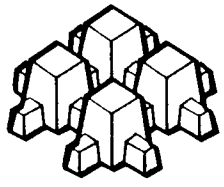
Porous pavement materials

Provision: *This provision is intended to require the use of well-known permeable materials to replace impermeable pavements so runoff can be treated and infiltrated in the underlying soil.*

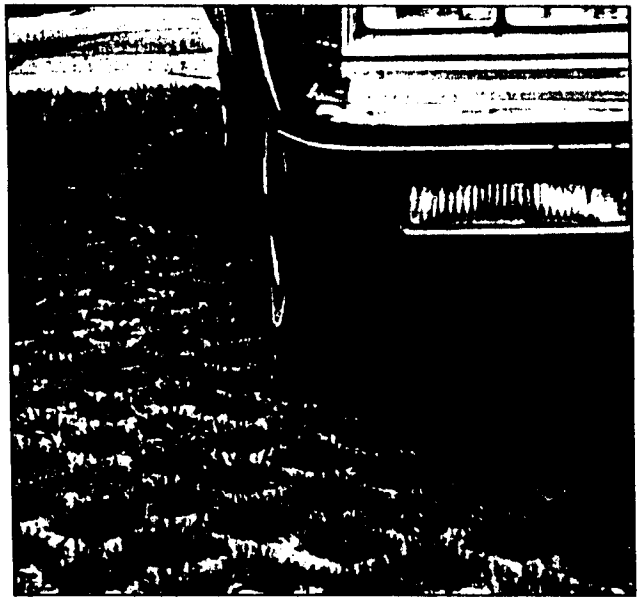
Example of typical existing provision:	Example of potential provision:
Pavement composition shall be 2" Type E or F wearing course and 6" Graded Aggregate Base, with subgrade compacted to 95% dry density. [This specification produces an impervious surface.]	Porous pavement may be used for street pavements, and shall be used on all public and private driveways, parking lots, sidewalks, bike and footpaths walkways, and pedestrian plazas and courts, except where it is infeasible due to site-specific constraints such as steep unstable slopes, swelling soils, proximity of structural foundations, or steep slope of pavement subgrade. In new developments and in additions to developments where similar porous pavements have not previously been used, representative portions of porous pavements shall be marked by permanent stencil or sign identifying the porous pavements, their purposes, and special restraint that needs to be taken in using and maintaining them.



Lattice paver



Castellated paver



Materials recommended in this provision can easily be incorporated into the landscape.

Purpose:

- For areas that must unavoidably be paved, porous pavement materials limit runoff at the paved source. They eliminate auto oil and other street pollutants by treating them in contact with the soil wherever they are generated.
- However, permeable pavement should not be used in specific site conditions where additional soil moisture might endanger the pavement or adjacent slopes or structures. Conditions such as swelling soils, highly plastic soils, proximity to foundations of structures, and steep slopes where moving water in the base course could erode the subgrade must be identified on each specific site prior to design.

Issues:

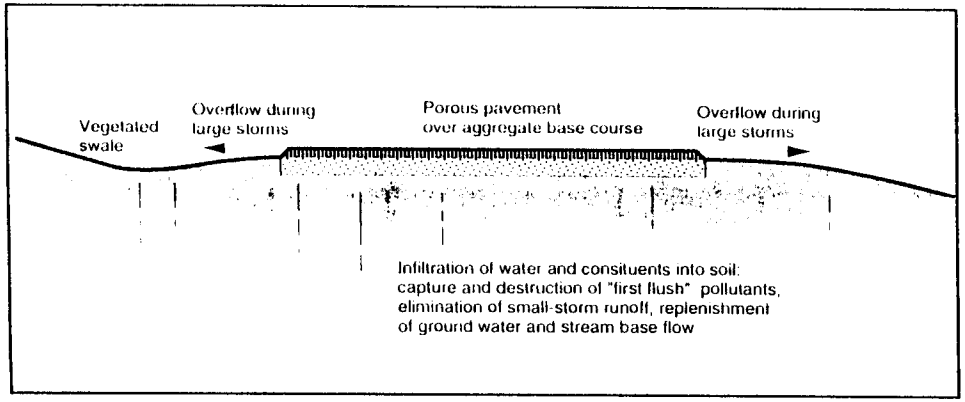
- Streets and the automobiles that use them are concentrated sources of runoff and pollution in all land use types. For the heavy traffic loads of public streets and the traveling lanes of parking lots, the available porous pavement materials are porous asphalt (Thelen and Howe, 1978) and porous concrete (Florida Concrete and Products Association, no date).
- The first installation of porous asphalt in Georgia was a residential driveway in Macon, constructed on "Helena" clay soil in 1990 to protect the root zones of nearby trees. The figure shows the pavement materials. The pavement is still in excellent condition, and the trees area still thriving. More recently, the state DOT has been using a porous asphalt su ce as an overlay on impervious concrete highways to improve traction and visibility. It can be seen, for example, in the HOV (high-occupancy vehicle) lanes on Interstate highways around Atlanta. DOT specifies this material as pavement type D (Georgia DOT Standard Specifications section 828.02, "Open Graded Surface Mixture"). This mix differs from other surfacing materials in that it uses a uniformly sized, open-graded aggregate (#7), rather than a graded mixture of sizes.
- The first installation of porous concrete in Georgia was a driveway at the Southface Energy and Environmental Resource Center in Atlanta, constructed in 1996. The principle features of porous concrete are analogous to those of porous asphalt: open-graded aggregate bound by portland cement.
- In many technical respects porous asphalt and concrete pavements are superior to their impermeable cousins. They are better drained, because water falls through the voids in the pavement surface. In wet weather they produce better traction and better visibility, because they

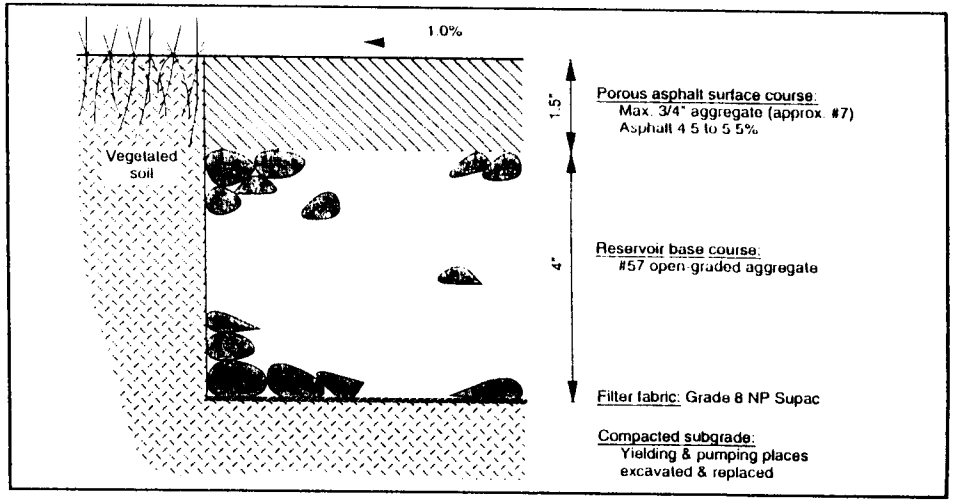
Figure A-12

Source: Land Development P sions to Protect Georgia Water Quality

are not covered with a sheet of surface water and vehicles don't kick up mist from their wheels. They produce less noise and glare. Their structural performance is in most respects equal or superior, because saturation of the subgrade during storms is already within the design guidelines for all pavements (Forsyth, 1991, p. 4; National Stone Association, 1987, p. 7; Sorvig, 1993; Thelen and Howe, 1978).

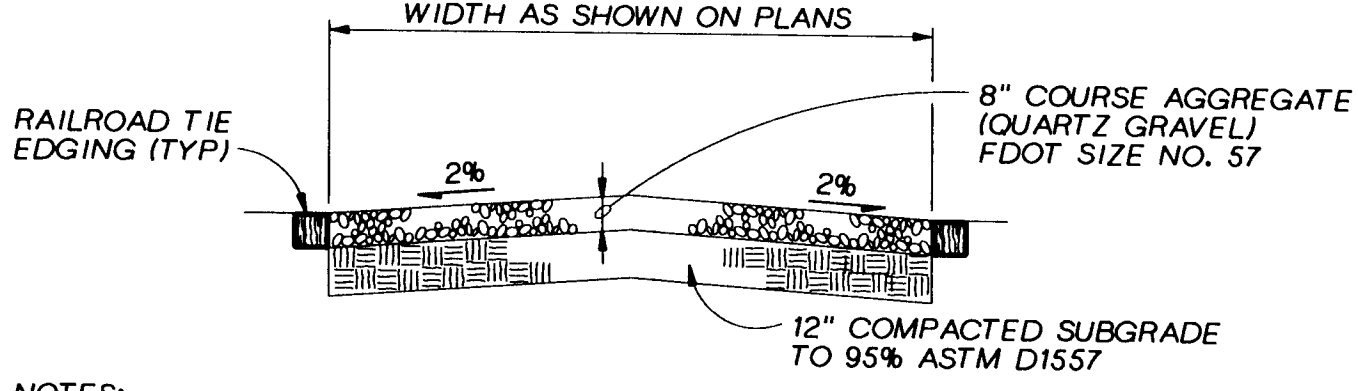
- Porous asphalt and porous concrete add about 10 percent to the cost of a pavement, because they are little used and constitute specialty items. This markup could disappear with increased use. In addition, porous pavement is not just a pavement structure; it is also part of the runoff treatment and drainage system. On sites where something must be done to treat runoff, the use of porous pavement eliminates the necessity for specialized treatment structures downstream. On favorable sites with sandy, highly permeable Coastal Plain soils, porous pavement can save more than 30 percent of the combined cost of pavements and drainage (Sorvig, 1993).
- For the light traffic loads of pedestrian, parking and driveway pavements, porous asphalt and concrete are joined by a wide variety of simple, familiar, inexpensive materials such as aggregate and turf. To make parking pavements permeable is to eliminate one of the least necessary sources of urban runoff. Parking lots occupy more than half the area of commercial sites, but parking spaces distant from building entrances are hardly ever used. Although parking pavements produce only moderate concentrations of pollutants, their size and consequent volume of runoff are enormous (Arnold and Gibbons, 1996).
- Permeable crushed stone ("gravel") aggregate is cost-competitive with almost any other pavement material. The aggregate must be open-graded in order to be permeable and to avoid yielding fine particles that wash into streams. Parking must be clearly organized in order for the area not to appear abandoned or neglected. On aggregate where painted lines are not possible, parking can be organized by bollards, wheel stops of concrete or wood, arrangements of planted trees, or paved traveling lanes adjacent to the stalls. Incidental or long-term parking such as that of RVs and boats is very appropriate for crushed stone surfaces, because of the small amount of moving traffic.
- Open-celled pavers are concrete or plastic grids with voids that are filled with porous topsoil and seeded, or filled with porous aggregate (Southerland, 1984). An example is a grass-covered access lane at the Southface Energy and Environmental Resource Center in Atlanta. Commercially available pavers differ in their construction cost and difficulty for some persons to walk on (Nichols, 1995; Sipes and Roberts, 1994).
- Grass has been used everywhere for overflow parking, where it maintains its health, appearance and permeability at parking frequencies up to once per week. Reinforced turf is economical for occasionally used parking surfaces and emergency access lanes.
- For pedestrian areas other materials are wooden decks, well spaced paving stones, and wood mulch (Ferguson, 1994, p. 52-55).





Top: Porous materials limit runoff at the paved source.
Right: Porous pavement installed in a Macon Driveway in 1990.

Figure A-12 (continued)



NOTES:

1. QUARTZ GRAVEL TO CONFORM TO FDOT STD SPEC 901.
2. PLACE COARSE AGGREGATE ON GEOTEXTILE FABRIC. (FDOT SPEC 985)

TYPICAL GRAVEL TRAIL

NTS

FIGURE A-13

Attachment D: Cost Forms

The cost tables have changed slightly from the *Watershed Assessment of Cogdel's Creek* because of reformatting to use the MCB Camp Lejeune Form 1391. Tables D-1 and D-2 summarize project costs, and are followed by individual cost sheets for each project. Total program cost is approximately $6.9 million for strategic projects, and $5.8 million for comprehensive creek restoration.

Order of magnitude construction costs were estimated in 1998 dollars, using published cost reference materials and the estimator's experience. An allowance of 25 percent for engineering design, inspection, and permitting has been included, as well as a 25 percent contingency. On-going maintenance costs and interim temporary measures are not included. Actual project cost will depend upon final project design, actual labor and material costs, actual site conditions, productivity, competitive market conditions, and other variable factors at the time of the project bid. Order of magnitude costs are considered accurate to within minus 30 percent or plus 50 percent, according to the definition published by the American Association of Cost Engineers.

Table B-1. Strategic Remediation Project Costs

Cogdel's Creek Watershed

Site No.	Location	Description	Cost [1]
1	G816 Area	Gravel 30%, add storm drains w/sand traps, revegetate	$502,000
2	Tank Trail Area	Add improved tank trail, revegetate sand areas, limit access	$1,239,000
3	FC-100 Area	Pave 50%, add pond, regrade, extend storm sewer, add grassed swales	$790,000
4	FC-200 Area	Pave 90%, enlarge pond, improve outlet, add storm sewers	$1,711,000
5	Landfill Area	Review completion plan to ensure erosion minimized	None
6	Building 1775 Area	Vegetate buffer, add sand trap inlets, regrade	$88,000
7	Building 1450 Area	Repair/rebuild pipe inlets to pond, revegetate, regrade, enlarge pond to handle area north of Louis Road	$627,000
8	MT/ENG Building Area	Construct sediment pond east of building, armor ravine, revegetate bare areas	$906,000
9	463L Pallet Loading Area	Install vegetated buffer, regrade unvegetated areas	$79,000
10-18 [2]	Culvert, At-grade, and ORRV Crossings	Clean out and repair culverts, eliminate at-grade stream crossings, and restore channel cross-section	$414,000
		Total for Phase 1 Projects	**$ 6,356,000**

[1] Order of magnitude costs are considered accurate to within minus 30 percent and plus 50 percent.

[2] Includes sites 10a, 11a, 12a, 13a, 14a, 15a, 16a, 17a, and 18.

Table B-2. Comprehensive Remediation Project Costs

Cogdel's Creek Watershed

Site No.	Location	Description	Cost [1]
10b	Upstream Building 1854 Culvert Crossing	Restore channel for 1,300 feet upstream	$1,241,000
11b	Upstream Main Service Road Culvert Crossing	Restore channel for 850 feet upstream	$606,000
12b	Upstream P804 Culvert Crossing	Restore channel for 1,600 feet upstream	$1,327,000
13b	Upstream Sneads Ferry Road Culvert Crossing	Restore channel for 500 feet upstream	$330,000
14b	Upstream At-Grade Crossing 2	Restore channel for 700 feet upstream	$884,000
15b	Upstream and Downstream At-Grade Crossing 1	Restore channel for 400 feet upstream and 400 feet downstream	$732,000
16b	Upstream At-Grade Crossing 4	Restore channel for 350 feet upstream	$193,000
17b	Upstream At-Grade Crossing 3	Restore channel for 550 feet upstream	$467,000
		Total for Phase 2 Projects	**$5,780,000**

[1] Order of magnitude costs are considered accurate to within minus 30 percent and plus 50 percent.

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA			2. DATE 9/30/98
3. INSTALLATION AND LOCATION		4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 1		
5. PRG ELEMENT	6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST	$ 501,552

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
VEGETATION BUFFER				
Site Grading	SY	8,356	0.85	7,103
4" topsoil placement	SY	8,356	2.06	17,213
Erosion protection mats	SY	8,356	1.26	10,529
Vegetation	SY	8,356	0.40	3,342
SAND TRAPS				
Double Manhole Sandtrap	EA	5	5390.00	26,950
18" Sewer Pipe RCP	LF	250	26.25	6,563
SURFACE ENHANCEMENT				
Site Grading	SY	53,244	0.85	45,257
4" topsoil placement	SY	21,298	2.06	43,874
Vegetation	SY	21,298	0.40	8,519
Place/Grade Gravel Base Course, 14" thk	SY	15,973	7.78	124,270
SITE COST SUBTOTAL				$293,620
ENGINEERING INSPECTION (7%)				20,553
SURVEYING AND PERMITTING (10%)				29,362
SUBTOTAL				$344,000
CONTINGENCIES (25%)				86,000
TOTAL CONTRACT COST				430,000
S.I.O.H. (8%)				34,400
TOTAL FUNDED COST				464,400
DESIGN COST (8%)				37,152
TOTAL REQUEST				$501,552

COMPTRAK: 60001

10. Description of Proposed Construction:

Vegetate a buffer (50 feet wide) along the main service road and along the edge of the ditch. Install inlets with sand traps and make surface enhancements to promote infiltration and direct runoff.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), and 15A NCAC 07H .0200 (Coastal Area Management).

Requirements:

Prevent erosion of area surrounding Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 2	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 1,238,345

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
NEW TANK TRAIL				
Base Course, 30'Wx12" thk w/fabric	LF	4,600	30.36	139,656
Corrugated Metal Culverts, 40' long, 15" diameter	EA	10	1000.00	10,000
TRAFFIC POST				
Traffic deterrent post, 8' high	EA	598	305.00	182,390
ABANDONED TRAIL SURFACE RESTORATION				
Site grading	SY	50,000	0.85	42,500
4" topsoil placement	SY	50,000	2.06	103,000
Vegetation	SY	50,000	0.40	20,000
OPEN AREA				
Site grading	SY	69,000	0.85	58,650
4" topsoil placement	SY	69,000	2.06	142,140
Vegetation	SY	69,000	0.40	27,600
SITE COST SUBTOTAL				725,936
ENGINEERING INSPECTION (7%)				50,816
SURVEYING AND PERMITTING (10%)				72,594
SUBTOTAL				$849,345
CONTINGENCIES (25%)				212,336
TOTAL CONTRACT COST				1,061,681
S.I.O.H. (8%)				84,935
TOTAL FUNDED COST				1,146,616
DESIGN COST (8%)				91,729
TOTAL REQUEST				$1,238,345

COMPTRAK: 60001

10. **Description of Proposed Construction:**
Construct 4,600 feet of new gravel tank trail as shown to access the improved tank trail northeast of Sneads Ferry Road. In the open area, construct berms along down slope areas to spread concentrated flows and promote temporary ponding and infiltration along the perimeter area. Install posts or fences to protect vegetated areas from traffic and to restrict access to Codgel's Creek.

11. **Requirements:**

Project:
Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), and 15A NCAC 07H .0200 (Coastal Area Management).

Requirements:
Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:
A current watershed assessment of Cogdel's Creek indicates severe sediment and errosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:
If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's D39Creek Watershed Assessment Site 3	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 789,896

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
VEGETATION BUFFER				
Site Grading	SY	5278	0.85	4,486
4" topsoil placement	SY	5278	2.06	10,873
Erosion protection mats	SY	5278	1.26	6,650
Vegetation	SY	5278	0.40	2,111
STORM SEWER & SAND TRAPS				
Double Manhole Sandtrap	EA	6	5390	32,340
18" Sewer Pipe RCP	LF	200	26.25	5,250
27" Sewer Pipe RCP	LF	350	84.70	29,645
36" Sewer Pipe RCP	LF	330	150.70	49,731
DITCH RIP-RAP				
12" deep rip-rap 50lb rock, stab. fabric	SY	100	6.45	645
SURFACE ENHANCEMENT				
Site Grading	SY	26533	0.85	22,553
4" topsoil placement	SY	6633	2.06	13,664
Vegetation	SY	6633	0.40	2,653
Replace Gate with Fence	LF	30	15.00	450
Place/Grade Base Course, 10" thk	SY	13267	5.56	73,765
Asphalt Binder, 2" thk	SY	13267	4.00	53,068
Asphalt, Wearing Course, 2" thk	SY	13267	4.50	59,702
POND				
Excavation and Disposal	CY	2904	10.22	29,679
Fence	LF	900	15.00	13,500
Outlet Pipe 48"	LF	160	193.60	30,976
Outlet Structure	EA	2	3040.00	6,080
4" topsoil placement	SY	1111	2.06	2,289
Seeding	SY	1111	0.40	444
Baffle	SY	33	152.50	5,033
Tree Removal & Grub	AC	0.5	14925.00	7,463
SITE COST SUBTOTAL				463,049
ENGINEERING INSPECTION (7%)				32,413
SURVEYING AND PERMITTING (10%)				46,305
SUBTOTAL				$541,767
CONTINGENCIES (25%)				135,442
TOTAL CONTRACT COST				677,209
S.I.O.H. (8%)				54,177
TOTAL FUNDED COST				731,385
DESIGN COST (8%)				58,511
TOTAL REQUEST				$789,896

COMPTRAK: 60001

10. Description of Proposed Construction:

Install a 50-foot wide grassed swale along the east and south perimeter of FC-100. Provide stone reinforcement in the ditch bottom where necessary to reduce ditch erosion. Extend the storm sewer located along the west side of FC-100 to the north edge of the sand parking area and along the north edge of the parking area. Construct a sediment pond at the north border of the site between FC-120 and FC-100.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), and 15A NCAC 07H .0200 (Coastal Area Management).

Requirements:

Prevent erosion of area surrounding Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 4	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 1,710,186

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
DITCH TO COGDEL'S CREEK				
excavation	CY	642	10.22	6,561
4" topsoil placement	SY	312	2.06	643
Erosion protection mats	SY	312	1.26	393
Vegetation	SY	312	0.4	125
STORM SEWER & SAND TRAPS				
Double Manhole Sandtrap	EA	6	5390	32,340
18" Sewer Pipe RCP	LF	200	26.25	5,250
27" Sewer Pipe RCP	LF	450	84.70	38,115
36" Sewer Pipe RCP	LF	400	150.70	60,280
48" Sewer Pipe RCP	LF	150	193.60	29,040
SURFACE ENHANCEMENT				
Site grading	SY	47133	0.85	40,063
Place/Grade Base Course, 10" thk	SY	47133	5.56	262,059
Asphalt Binder, 2" thk	SY	47133	4.00	188,532
Asphalt, Wearing Course, 2" thk	SY	47133	4.50	212,099
POND				
Excavation and Disposal	CY	3678	10.22	37,589
Fence	LF	490	15.00	7,350
Outlet Pipe 54"	LF	150	224.40	33,660
Outlet Structure	EA	1	3040.00	3,040
4" topsoil placement	SY	12444	2.06	25,635
Seeding	SY	12444	0.40	4,978
Rock Spillway, stab. fabric	SY	667	11.42	7,617
Baffle	SY	47	152.5	7,168
SITE COST SUBTOTAL				1,002,536
ENGINEERING INSPECTION (7%)				70,178
SURVEYING AND PERMITTING (10%)				100,254
SUBTOTAL				$1,172,967
CONTINGENCIES (25%)				293,242
TOTAL CONTRACT COST				1,466,209
S.I.O.H. (8%)				117,297
TOTAL FUNDED COST				1,583,506
DESIGN COST (8%)				126,680
TOTAL REQUEST				$1,710,186

COMPTRAK: 60001

10. **Description of Proposed Construction:**

Install storm sewers and pave 90 percent of the surface restoration area. Grade and vegetate unpaved areas to slow runoff and promote infiltration. Enlarge the sedimentation basin along the north edge of the site to accommodate runoff and promote infiltration. Establish the alignment of the tank trail to the north of the site and vegetate bare soil areas adjacent to the tank trail.

11. **Requirements:**

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), and 15A NCAC 07H .0200 (Coastal Area Management).

Requirements:

Prevent erosion of area surrounding Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact if Not Provided:

If project not funded, Marine Corps base. Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 6	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 87,751

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STORM SEWER AND SAND TRAPS				
Double Manhole Sandtrap	EA	3	5390	16,170
18" Sewer Pipe RCP	LF	210	26.25	5,513
DITCH REPAIR				
Site Grading	SY	433	0.85	368
12" deep rip-rap 50lb rock, stab. fabric	SY	433	6.45	2,793
SURFACE ENHANCEMENT				
Site Grading	SY	21956	0.85	18,663
4" topsoil placement	SY	2133	2.06	4,394
Erosion protection mats	SY	2133	1.26	2,688
Vegetation	SY	2133	0.40	853
SITE COST SUBTOTAL				51,441
ENGINEERING INSPECTION (7%)				3,601
SURVEYING AND PERMITTING (10%)				5,144
SUBTOTAL				$60,186
CONTINGENCIES (25%)				15,046
TOTAL CONTRACT COST				75,232
S.I.O.H. (8%)				6,019
TOTAL FUNDED COST				81,251
DESIGN COST (8%)				6,500
TOTAL REQUEST				$87,751

COMPTRAK: 60001

10. Description of Proposed Construction:

Vegetate a buffer (50 feet wide) along Duncan Street (200ft) and the edge of the ditch (300ft). Install inlets with sand traps, drop manholes in vegetated buffer (3 structures) and install erosion protection at the storm sewer outfall.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), and 15A NCAC 07H .0200 (Coastal Area Management).

Requirements:

Prevent erosion of area surrounding Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

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DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 7	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 626,723

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
VEGETATION BUFFER				
Site Grading	SY	7156	0.85	6,083
4" topsoil placement	SY	7156	2.06	14,741
Erosion protection mats	SY	7156	1.26	9,017
Vegetation	SY	7156	0.40	2,862
Traffic deterrent post, 8" high	EA	30	305.00	9,150
STORM SEWER & SAND TRAPS				
Storm Sewer Manhole	EA	3	3960.00	11,880
27" Sewer Pipe RCP	LF	90	84.70	7,623
48" Sewer Pipe RCP	LF	330	193.6	63,888
Restoration - 4" topsoil placement	SY	367	2.06	756
Restoration - vegetation	SY	367	0.40	147
POND				
Sediment Removal	CY	1000	23.20	23,200
Excavation and Disposal	CY	10067	10.22	102,885
Fence	LF	1600	15.00	24,000
Outlet Pipe 54"	LF	70	224.40	15,708
Outlet Structure	EA	1	5000.00	5,000
4" topsoil placement	SY	8889	2.06	18,311
Seeding	SY	8889	0.40	3,556
Erosion protection mats	SY	8889	1.26	11,200
Rock Spillway, stab. fabric	SY	583	11.42	6,658
Baffle	SY	133	152.50	20,283
Tree Removal & Grub	AC	0.7	14925.00	10,448
SITE COST SUBTOTAL				367,394
ENGINEERING INSPECTION (7%)				25,718
SURVEYING AND PERMITTING (10%)				36,739
SUBTOTAL				$429,651
CONTINGENCIES (25%)				107,463
TOTAL CONTRACT COST				537,314
S.I.O.H. (8%)				42,985
TOTAL FUNDED COST				580,299
DESIGN COST (8%)				46,424
TOTAL REQUEST				$626,723

COMPTRAK: 60001

10. Description of Proposed Construction:

Install a drop manhole and new inlet extension for the northerly inlet to the pond. Install a berm along the northeast fence line to prevent sheet flow from the paved parking area from causing erosion. Install an interceptor storm sewer from the 48-inch storm sewer to divert runoff from the industrial area (to the north) to the sediment basin. Enlarge the existing pond to accommodate the additional drainage area.

11. **Requirements:**

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), and 15A NCAC 07H .0200 (Coastal Area Management).

Requirements:

Prevent erosion of area surrounding Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 8	
5. PRG ELEMENT / 6. CAT. CODE / 7. PROJECT NUMBER	8. PROJECT COST $ 905,367	

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
SITE VEGETATION				
Site Grading	SY	8533	0.85	7,253
4" topsoil placement	SY	8533	2.06	17,578
Vegetation	SY	8533	0.40	3,413
Traffic deterrent post, 8' high	EA	8	305.00	2,440
STORM SEWER EXTENSION TO POND				
Storm Sewer Manhole	EA	6	3,960.00	23,760
18" Sewer Pipe RCP	LF	450	26.25	11,813
36" Sewer Pipe RCP	LF	300	150.70	45,210
48" Sewer Pipe RCP	LF	550	193.60	106,480
Restoration - 4" topsoil placement	SY	1194	2.06	2,460
Restoration - vegetation	SY	1194	0.40	478
POND				
Excavation and Disposal	CY	15811	10.22	161,588
Fence	LF	1450	15.00	21,750
Outlet Pipe 54"	LF	160	224.40	35,904
Outlet Structure	EA	1	5,000.00	5,000
4" topsoil placement	SY	8056	2.06	16,595
Seeding	SY	8056	0.40	3,222
Erosion protection mats	SY	8056	1.26	10,151
Rock Spillway, stab. fabric	SY	889	11.42	10,152
Baffle	SY	83	152.50	12,658
Tree Removal & Grub	AC	2.2	14,925.00	32,835
SITE COST SUBTOTAL				530,740
ENGINEERING INSPECTION (7%)				37,152
SURVEYING AND PERMITTING (10%)				53,074
SUBTOTAL				$620,965
CONTINGENCIES (25%)				155,241
TOTAL CONTRACT COST				776,207
S.I.O.H. (8%)				62,097
TOTAL FUNDED COST				838,303
DESIGN COST (8%)				67,064
TOTAL REQUEST				$905,367

COMPTRAK: 60001

10. Description of Proposed Construction:

Construct a sediment pond in the wooded area east of the MT/ENG. Building. The bottom of the ravine will be armored with stone (500ft) to reduce the rate of erosion at the toe of the ravine and the resulting erosion up the ravine side slopes. Revegetate bare soil areas in the vicinity o the MT/ENG. Building.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), and 15A NCAC 07H .0200 (Coastal Area Management).

Requirements:

Prevent erosion of area surrounding Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA			2. DATE 9/30/98
3. INSTALLATION AND LOCATION		4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 9		
5. PRG ELEMENT	6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST	$ 78,303

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
SURFACE ENHANCEMENT				
Site Grading	SY	25022	0.85	21,269
4" topsoil placement	SY	6622	2.06	13,641
Erosion protection mats	SY	6622	1.26	8,344
Vegetation	SY	6622	0.40	2,649
SITE COST SUBTOTAL				45,903
ENGINEERING INSPECTION (7%)				3,213
SURVEYING AND PERMITTING (10%)				4,590
SUBTOTAL				$53,706
CONTINGENCIES (25%)				13,426
TOTAL CONTRACT COST				67,132
S.I.O.H. (8%)				5,371
TOTAL FUNDED COST				72,503
DESIGN COST (8%)				5,800
TOTAL REQUEST				$78,303

COMPTRAK: 60001

10. **Description of Proposed Construction:**
Install a vegetated buffer along the southwest and southeast border of the site (50 to 75 feet wide and 800 feet long). Install a level berm in the south corner of the site to contain runoff. Regrade unvegetated sand areas with terraces to slow runoff and promote infiltration.

11. Requirements:

Project:
Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), and 15A NCAC 07H .0200 (Coastal Area Management).

Requirements:
Prevent erosion of area surrounding Cogdel's Creek.

Current Situation:
A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:
If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 10a	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 80,184

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Clamshell Mob/Demob	EA	2	350.00	700
Culvert Sediment Removal	CY	141	9.82	1,385
Other Sediment Removal	CY	111	15.00	1,665
Veg. (geotextile, sprigs)	LF	700	25.00	17,500
Erosion protection mats	SY	3467	1.26	4,368
Other Grassed Vegetation	SY	3467	0.40	1,387
42" RCP repair, Class III w/gaskets	LF	80	250.00	20,000
				0
				0
SITE COST SUBTOTAL				47,005
ENGINEERING INSPECTION (7%)				3,290
SURVEYING AND PERMITTING (10%)				4,700
SUBTOTAL				$54,996
CONTINGENCIES (25%)				13,749
TOTAL CONTRACT COST				68,745
S.I.O.H. (8%)				5,500
TOTAL FUNDED COST				74,244
DESIGN COST (8%)				5,940
TOTAL REQUEST				$80,184

COMPTRAK: 60001

10. Description of Proposed Construction:

Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream, including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 11a	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 35,942

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Clamshell Mob/Demob	EA	2	350.00	700
Culvert Sediment Removal	CY	141	9.82	1,385
Other Sediment Removal	CY	111	15.00	1,665
Veg. (geotextile, sprigs)	LF	560	25.00	14,000
Erosion protection mats	SY	2000	1.26	2,520
Other Grassed Vegetation	SY	2000	0.40	800
SITE COST SUBTOTAL				21,070
ENGINEERING INSPECTION (7%)				1,475
SURVEYING AND PERMITTING (10%)				2,107
SUBTOTAL				$24,651
CONTINGENCIES (25%)				6,163
TOTAL CONTRACT COST				30,814
S.I.O.H. (8%)				2,465
TOTAL FUNDED COST				33,279
DESIGN COST (8%)				2,662
TOTAL REQUEST				$35,942

COMPTRAK: 60001

10. Description of Proposed Construction:

Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream, including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 12a	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 52,885

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Clamshell Mob/Demob	EA	2	350.00	700
Culvert Sediment Removal	CY	37	9.82	363
Other Sediment Removal	CY	333	15.00	4,995
Veg. (geotextile, sprigs)	LF	800	25.00	20,000
Erosion protection mats	SY	2978	1.26	3,752
Other Grassed Vegetation	SY	2978	0.40	1,191
SITE COST SUBTOTAL				31,002
ENGINEERING INSPECTION (7%)				2,170
SURVEYING AND PERMITTING (10%)				3,100
SUBTOTAL				$36,272
CONTINGENCIES (25%)				9,068
TOTAL CONTRACT COST				45,340
S.I.O.H. (8%)				3,627
TOTAL FUNDED COST				48,967
DESIGN COST (8%)				3,917
TOTAL REQUEST				$52,885

COMPTRAK: 60001

10. Description of Proposed Construction:

Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream, including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 13a	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 43,214

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Clamshell Mob/Demob	EA	2	350.00	700
Culvert Sediment Removal	CY	141	9.82	1,385
Other Sediment Removal	CY	167	15.00	2,505
Veg. (geotextile, sprigs)	LF	660	25.00	16,500
Erosion protection mats	SY	2556	1.26	3,221
Other Grassed Vegetation	SY	2556	0.40	1,022
SITE COST SUBTOTAL				25,333
ENGINEERING INSPECTION (7%)				1,773
SURVEYING AND PERMITTING (10%)				2,533
SUBTOTAL				$29,639
CONTINGENCIES (25%)				7,410
TOTAL CONTRACT COST				37,049
S.I.O.H. (8%)				2,964
TOTAL FUNDED COST				40,013
DESIGN COST (8%)				3,201
TOTAL REQUEST				$43,214

COMPTRAK: 60001

10. **Description of Proposed Construction:**
Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream, including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:
Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:
Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:
A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:
If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA			2. DATE 9/30/98
3. INSTALLATION AND LOCATION		4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 14a		
5. PRG ELEMENT	6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST	$ 26,819

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Other Sediment Removal	EA	142	15.00	2,130
Veg. (geotextile, sprigs)	CY	160	25.00	4,000
Erosion protection mats	CY	5778	1.26	7,280
Other Grassed Vegetation	LF	5778	0.40	2,311
SITE COST SUBTOTAL				15,721
ENGINEERING INSPECTION (7%)				1,101
SURVEYING AND PERMITTING (10%)				1,572
SUBTOTAL				$18,394
CONTINGENCIES (25%)				4,599
TOTAL CONTRACT COST				22,993
S.I.O.H. (8%)				1,839
TOTAL FUNDED COST				24,832
DESIGN COST (8%)				1,987
TOTAL REQUEST				$26,819

COMPTRAK: 60001

10. Description of Proposed Construction:

Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream, including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA			2. DATE 9/30/98
3. INSTALLATION AND LOCATION		4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 15a		
5. PRG ELEMENT	6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST	$ 56,655

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Other Sediment Removal	EA	231	15.00	3,465
Veg. (geotextile, sprigs)	CY	1060	25.00	26,500
Erosion protection mats	CY	1956	1.26	2,465
Other Grassed Vegetation	LF	1956	0.40	782
SITE COST SUBTOTAL				33,212
ENGINEERING INSPECTION (7%)				2,325
SURVEYING AND PERMITTING (10%)				3,321
SUBTOTAL				$38,858
CONTINGENCIES (25%)				9,714
TOTAL CONTRACT COST				48,572
S.I.O.H. (8%)				3,886
TOTAL FUNDED COST				52,458
DESIGN COST (8%)				4,197
TOTAL REQUEST				$56,655

COMPTRAK: 60001

10. Description of Proposed Construction:

Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream, including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 16a	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 24,465

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Other Sediment Removal	EA	414	15.00	6,210
Veg. (geotextile, sprigs)	CY	160	25.00	4,000
Erosion protection mats	CY	2489	1.26	3,136
Other Grassed Vegetation	LF	2489	0.40	996
SITE COST SUBTOTAL				14,342
ENGINEERING INSPECTION (7%)				1,004
SURVEYING AND PERMITTING (10%)				1,434
SUBTOTAL				$16,780
CONTINGENCIES (25%)				4,195
TOTAL CONTRACT COST				20,975
S.I.O.H. (8%)				1,678
TOTAL FUNDED COST				22,653
DESIGN COST (8%)				1,812
TOTAL REQUEST				$24,465

COMPTRAK: 60001

10. Description of Proposed Construction:

Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream, including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 17a	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 48,267

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Other Sediment Removal	EA	833	15.00	12,495
Veg. (geotextile, sprigs)	CY	300	25.00	7,500
Erosion protection mats	CY	5000	1.26	6,300
Other Grassed Vegetation	LF	5000	0.40	2,000
SITE COST SUBTOTAL				28,295
ENGINEERING INSPECTION (7%)				1,981
SURVEYING AND PERMITTING (10%)				2,830
SUBTOTAL				$33,105
CONTINGENCIES (25%)				8,276
TOTAL CONTRACT COST				41,381
S.I.O.H. (8%)				3,311
TOTAL FUNDED COST				44,692
DESIGN COST (8%)				3,575
TOTAL REQUEST				$48,267

COMPTRAK: 60001

10. Description of Proposed Construction:

Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream, including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 18	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 41,959

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
STRATEGIC REMEDIATION				
Other Sediment Removal	CY	444	15.00	6,660
Veg. (geotextile, sprigs)	LF	200	25.00	5,000
Traffic deterrant post, 8' high	EA	40	305.00	12,200
Erosion protection mats	SY	444	1.26	559
Other Grassed Vegetation	SY	444	0.40	178
SITE COST SUBTOTAL				24,597
ENGINEERING INSPECTION (7%)				1,722
SURVEYING AND PERMITTING (10%)				2,460
SUBTOTAL				$28,779
CONTINGENCIES (25%)				7,195
TOTAL CONTRACT COST				35,973
S.I.O.H. (8%)				2,878
TOTAL FUNDED COST				38,851
DESIGN COST (8%)				3,108
TOTAL REQUEST				$41,959

COMPTRAK: 60001

10. Description of Proposed Construction:

Clean out culverts and repair culverts and headwalls as needed. Remove at-grade and ORRV crossings. Restore the channel cross-section for 50 feet upstream and 50 feet downstream. including inlet and outlet protection. Stabilize the edges of crossing to prevent erosion.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 10b	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 1,240,891

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
COMPREHENSIVE REMEDIATION				
Sediment Removal	CY	722	15.00	10,830
Veg. (geotextile, sprigs)	LF	2600	25.00	65,000
Erosion protection mats	SY	722	1.26	910
Sediment Stockpile Vegetation	SY	722	0.40	289
Wetland Mit. (80% @ 3:1 impacted)	AC	27.1	20,000.00	542,000
Land for Wetland Mitigation	AC	27.1	4,000.00	108,400
SITE COST SUBTOTAL				727,429
ENGINEERING INSPECTION (7%)				50,920
SURVEYING AND PERMITTING (10%)				72,743
SUBTOTAL				$851,091
CONTINGENCIES (25%)				212,773
TOTAL CONTRACT COST				1,063,864
S.I.O.H. (8%)				85,109
TOTAL FUNDED COST				1,148,973
DESIGN COST (8%)				91,918
TOTAL REQUEST				$1,240,891

COMPTRAK: 60001

10. Description of Proposed Construction:

Restore the channel cross-section and profile for 1,300 feet upstream of the culverts and provide wetland mitigation as needed.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA			2. DATE 9/30/98
3. INSTALLATION AND LOCATION		4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 11b		
5. PRG ELEMENT	6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST	$ 605,859

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
COMPREHENSIVE REMEDIATION				
Sediment Removal	CY	472	15.00	7,080
Veg. (geotextile, sprigs)	LF	1700	25.00	42,500
Erosion protection mats	SY	472	1.26	595
Sediment Stockpile Vegetation	SY	472	0.40	189
Wetland Mit. (80% @ 3:1 impacted)	AC	12.7	20,000.00	254,000
Land for Wetland Mitigation	AC	12.7	4,000.00	50,800
SITE COST SUBTOTAL				355,164
ENGINEERING INSPECTION (7%)				24,861
SURVEYING AND PERMITTING (10%)				35,516
SUBTOTAL				$415,541
CONTINGENCIES (25%)				103,885
TOTAL CONTRACT COST				519,427
S.I.O.H. (8%)				41,554
TOTAL FUNDED COST				560,981
DESIGN COST (8%)				44,878
TOTAL REQUEST				$605,859

COMPTRAK: 60001

10. Description of Proposed Construction:

Restore the channel cross-section and profile for 850 feet upstream of the culverts and provide wetland mitigation as needed.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 12b	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 1,326,550

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
COMPREHENSIVE REMEDIATION				
Sediment Removal	CY	3556	15.00	53,340
Veg. (geotextile, sprigs)	LF	3200	25.00	80,000
Erosion protection mats	SY	3556	1.26	4,481
Sediment Stockpile Vegetation	SY	3556	0.40	1,422
Wetland Mit. (80% @ 3:1 impacted)	AC	26.6	20,000.00	532,000
Land for Wetland Mitigation	AC	26.6	4,000.00	106,400
SITE COST SUBTOTAL				777,643
ENGINEERING INSPECTION (7%)				54,435
SURVEYING AND PERMITTING (10%)				77,764
SUBTOTAL				$909,842
CONTINGENCIES (25%)				227,461
TOTAL CONTRACT COST				1,137,303
S.I.O.H. (8%)				90,984
TOTAL FUNDED COST				1,228,287
DESIGN COST (8%)				98,263
TOTAL REQUEST				$1,326,550

COMPTRAK: 60001

10. Description of Proposed Construction:

Restore the channel cross-section and profile for 1,600 feet upstream of the culverts and provide wetland mitigation as needed.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA			2. DATE 9/30/98
3. INSTALLATION AND LOCATION		4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 13b		
5. PRG ELEMENT	6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST	$ 329,567

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
COMPREHENSIVE REMEDIATION				
Sediment Removal	CY	444	15.00	6,660
Veg. (geotextile, sprigs)	LF	1000	25.00	25,000
Erosion protection mats	SY	444	1.26	559
Sediment Stockpile Vegetation	SY	444	0.40	178
Wetland Mit. (80% @ 3:1 impacted)	AC	6.7	20,000.00	134,000
Land for Wetland Mitigation	AC	6.7	4,000.00	26,800
SITE COST SUBTOTAL				193,197
ENGINEERING INSPECTION (7%)				13,524
SURVEYING AND PERMITTING (10%)				19,320
SUBTOTAL				$226,041
CONTINGENCIES (25%)				56,510
TOTAL CONTRACT COST				282,551
S.I.O.H. (8%)				22,604
TOTAL FUNDED COST				305,155
DESIGN COST (8%)				24,412
TOTAL REQUEST				$329,567

COMPTRAK: 60001

10. Description of Proposed Construction:

Restore the channel cross-section and profile for 500 feet upstream of the culverts and provide wetland mitigation as needed.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Prevent erosion of area surrounding Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 14b	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 883,913

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
COMPREHENSIVE REMEDIATION				
Sediment Removal	CY	622	15.00	9,330
Veg. (geotextile, sprigs)	LF	1400	25.00	35,000
Erosion protection mats	SY	622	1.26	784
Sediment Stockpile Vegetation	SY	622	0.40	249
Wetland Mit. (80% @ 3:1 impacted)	AC	19.7	20,000.00	394,000
Land for Wetland Mitigation	AC	19.7	4,000.00	78,800
SITE COST SUBTOTAL				518,163
ENGINEERING INSPECTION (7%)				36,271
SURVEYING AND PERMITTING (10%)				51,816
SUBTOTAL				$606,250
CONTINGENCIES (25%)				151,563
TOTAL CONTRACT COST				757,813
S.I.O.H. (8%)				60,625
TOTAL FUNDED COST				818,438
DESIGN COST (8%)				65,475
TOTAL REQUEST				$883,913

COMPTRAK: 60001

10. Description of Proposed Construction:

Restore the channel cross-section and profile for 700 feet upstream of the crossing and provide wetland mitigation as needed.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA			2. DATE 9/30/98
3. INSTALLATION AND LOCATION		4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 15b		
5. PRG ELEMENT	6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST	$ 731,573

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
COMPREHENSIVE REMEDIATION				
Sediment Removal	CY	1156	15.00	17,340
Veg. (geotextile, sprigs)	LF	1600	25.00	40,000
Erosion protection mats	SY	1156	1.26	1,457
Sediment Stockpile Vegetation	SY	1156	0.40	462
Wetland Mit. (80% @ 3:1 impacted)	AC	15.4	20,000.00	308,000
Land for Wetland Mitigation	AC	15.4	4,000.00	61,600
SITE COST SUBTOTAL				428,859
ENGINEERING INSPECTION (7%)				30,020
SURVEYING AND PERMITTING (10%)				42,886
SUBTOTAL				$501,765
CONTINGENCIES (25%)				125,441
TOTAL CONTRACT COST				627,206
S.I.O.H. (8%)				50,176
TOTAL FUNDED COST				677,383
DESIGN COST (8%)				54,191
TOTAL REQUEST				$731,573

COMPTRAK: 60001

10. Description of Proposed Construction:

Restore the channel cross-section and profile for 400 feet upstream and 400 feet downstream of the crossing and provide wetland mitigation as needed.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 16b	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 192,241

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
COMPREHENSIVE REMEDIATION				
Sediment Removal	CY	816	15.00	12,240
Veg. (geotextile, sprigs)	LF	700	25.00	17,500
Erosion protection mats	SY	816	1.26	1,028
Sediment Stockpile Vegetation	SY	816	0.40	326
Wetland Mit. (80% @ 3:1 impacted)	AC	3.4	20,000.00	68,000
Land for Wetland Mitigation	AC	3.4	4,000.00	13,600
SITE COST SUBTOTAL				112,695
ENGINEERING INSPECTION (7%)				7,889
SURVEYING AND PERMITTING (10%)				11,269
SUBTOTAL				$131,853
CONTINGENCIES (25%)				32,963
TOTAL CONTRACT COST				164,816
S.I.O.H. (8%)				13,185
TOTAL FUNDED COST				178,001
DESIGN COST (8%)				14,240
TOTAL REQUEST				$192,241

COMPTRAK: 60001

10. **Description of Proposed Construction:**
Restore the channel cross-section and profile for 350 feet upstream of the crossing and provide wetland mitigation as needed.

11. **Requirements:**

Project:
Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:
Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:
A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:
If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391

1. COMPONENT	FY 1997 MILITARY CONSTRUCTION DATA	2. DATE 9/30/98
3. INSTALLATION AND LOCATION	4. PROJECT TITLE Cogdel's Creek Watershed Assessment Site 17b	
5. PRG ELEMENT / 6. CAT. CODE	7. PROJECT NUMBER	8. PROJECT COST $ 466,363

9. Cost Estimate

	U/M	QTY	UNIT COST	COST
COMPREHENSIVE REMEDIATION				
Sediment Removal	CY	1650	15.00	24,750
Veg. (geotextile, sprigs)	LF	1100	25.00	27,500
Erosion protection mats	SY	1650	1.26	2,079
Sediment Stockpile Vegetation	SY	1650	0.40	660
Wetland Mit. (80% @ 3:1 impacted)	AC	9.1	20,000.00	182,000
Land for Wetland Mitigation	AC	9.1	4,000.00	36,400
SITE COST SUBTOTAL				273,389
ENGINEERING INSPECTION (7%)				19,137
SURVEYING AND PERMITTING (10%)				27,339
SUBTOTAL				$319,865
CONTINGENCIES (25%)				79,966
TOTAL CONTRACT COST				399,831
S.I.O.H. (8%)				31,987
TOTAL FUNDED COST				431,818
DESIGN COST (8%)				34,545
TOTAL REQUEST				$466,363

COMPTRAK: 60001

10. Description of Proposed Construction:

Restore the channel cross-section and profile for 550 feet upstream of the crossing and provide wetland mitigation as needed.

11. Requirements:

Project:

Project design shall be in accordance with 15A NCAC 2H .1000 (Stormwater Management), GS 113A-57 (Sedimentation), 15A NCAC 07H .0200 (Coastal Area Management), and 15A NCAC 02B .0231 (Wetlands)

Requirements:

Remove and prevent sedimentation of Cogdel's Creek.

Current Situation:

A current watershed assessment of Cogdel's Creek indicates severe sediment and erosion control problems that could possibly lead to Notices of Violation.

Impact If Not Provided:

If project not funded, Marine Corps base, Camp Lejeune will continue to be out of compliance with GS 113A-57 State Sedimentation and face the potential requirement for future remedial action. Also, Camp Lejeune faces potential fines, administrative action or possible injunctions.

DD FORM 1391